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Pivotal Factors in Increasing Teacher Use of Technology

by

Gary R. Spence ©

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Education

in

Instructional Technology

Department of Adult, Career, and Technology Education

Edmonton, Alberta

Fall, 1995

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Dr. Craig Montgomerie

Dr. Milt Petruk

AK Deane
Professor Art Deane

September 22, 1995

Abstract

Critics of public education describe a system out of step with the demands of an information-based global society. A synthesis of the literature would suggest that what is needed is progress on three fronts simultaneously: a movement toward more active participation of students in acquiring knowledge and skills, a restructuring of the governance of education that sees more decision making moved closer to the client, and increased integration of computer technology to support the other two. Within this context, this study examines the level of integration of computers and four factors identified in the literature as being predictive of computer use: computer attitudes (affective — enjoy using computers, and cognitive — perceived relevance of using computers), perceived self-competence using computers, and teacher level of innovativeness. The relationship between these traits and the use of a specific application of technology (electronic mail) as well as the relationship between these traits and district support for technology is examined. Teachers from two school jurisdictions that recently amalgamated to form a regional division were asked to participate.

The study confirms the relationship between previously identified factors and the level of computer use, with perception of self-competence having the strongest positive correlation. Electronic mail was shown to have a positive correlation with the level of use of computers, and with all research-based predictor factors except innovativeness. Teachers from the two jurisdictions illustrated different traits with respect to the level of use of computers. Those with central office support demonstrated significantly higher levels of use and significantly higher levels on all research-based predictor factors except innovativeness.

The study concludes that access to electronic mail, valuable in its own right as a communications tool, is a valuable inservice tool to get teachers started using computers. The study also concludes that central office support for technology is an important factor in achieving higher levels of computer use by teachers.

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Chapter I

The Context and the Problem

Introduction

This study is about increasing the level of integration of technology on the part of practicing teachers. It is set within the overall context of educational reform. This chapter will introduce the study topic, provide a brief review of educational reform, clearly define the research problem, and provide the limitations and delimitations for this study.

Talk of educational reform is rampant of late. There seems to be a common notion that things need to change, but on how things should change there appears to be little consensus among stakeholders. The recent cuts to provincial education grants will make the need for doing things differently even more acute. Coincident with the grant reductions is a dramatic restructuring of the governance of education in Alberta. Alberta Education has taken over the collection and redistribution of local property taxes and has developed a framework which specifies how these funds can actually be spent by a local school board. Revenue generating authority has moved from local school boards to the provincial government. At the same time the recent restructuring is said by it's architects to provide more autonomy at the school level (Alberta Education, 1994). But is this restructuring sufficient to constitute actual reform? A look at the literature would suggest that a synergy of three outcomes or aspects of reform — restructuring, learner-centred approaches to teaching and learning, and well integrated use of technology — will be required if significant change is to occur. But to achieve such a synergy would require commitment to all three aspects of reform. In addition, each process for change would have to be implemented in a fashion that supports the other two.

This author accepts the thesis that increased integration of technology is a requisite for effective schools as they prepare young people for adult lives. This study will examine one aspect of this synergy by examining the effectiveness of electronic mail, an application hypothesized by the author to be pivotal in promoting positive attitudes towards technology, in increasing user confidence levels, in increasing the level of integration of technology, in achieving innovation and in facilitating new roles for teachers and students.

The context for this study — Educational Reform

In the 1830's, employers wanted a work force that would meet the needs of industrial society: they wanted workers who would work long hours, follow orders without question, do repetitive work, and show up on time (Hutchkins, 1990). The education system was designed to meet these needs and it worked well, bringing schooling to millions of immigrants who were needed to make industrial society work. Industrial society has given way to the so-called 'information age' and many contend that such a work force is no longer needed. Accumulated knowledge is growing rapidly and we clearly can no longer expect to provide our students with the knowledge needed to last a lifetime. Today's citizen needs to be a creative problem solver who uses information and technology, can work with others, and acts in an ethically and socially responsible manner (Williams, 1992). Human Resources Development Canada (HRDC) refers to 'basic skills' as enabling skills that provide a foundation for further learning. The HRDC *Basic Skills Research Project* explores what are now considered to be basic skills for Canadians: Problem Solving, Reading, Numeracy, Writing, Oral Communications, Information Technology, Working With Others, and Continuous Learning (Mair, 1994). A similar skill set is outlined by the Conference Board of Canada Corporate Council on Education in their Employability Skills Profile (Conference Board of Canada, 1990). The American Society for Training and Development echoes these skills in a paper entitled "Workplace Basics: The Skills Employers Want" (American Society for Training and Development & U.S. Department of Labor, 1990).

But schools are charged with preparing competent citizens, not just competent workers. Less vocationally specific, and perhaps more fundamentally tied to the well-being of Canada and Canadians, are concerns expressed by the Canadian Federal Advisory Council to the information highway. The concerns fall under the general category of Information Democracy. As more and more information becomes digital in nature, unequal access to information becomes more of a concern (Bray, 1994). An informed public is fundamental to democracy, and it is the schools that are charged with the responsibility to prepare students for citizenship. Mastery of this evolved basic skill set is therefore fundamental to the mission of schools.

There is no shortage of references to this new skill set in recent literature, yet it is questionable whether education has adjusted, or will be allowed to adjust, to these new needs of society. Certainly education has made adjustments to changing social conditions by providing many value-added services. But there is a considerable amount of concern that education is not adjusting to the changing life-skill needs of students.

Williams defines two waves of educational reform (Williams, 1992). The first wave focused on doing more of the same in education, rather than on actually changing the nature of education. This was termed by Leonard as a hoax; an educational horse and buggy. “They would improve the buggy, keep the passengers in it longer, and pay the driver more” (Leonard, 1984, p. 49-50). The second wave is much less defined, but is sometimes termed restructuring. As Sheingold, and Williams point out, the term is widely used, widely recognized as a need, but not clearly understood to have a consistent meaning (Sheingold, 1991; Williams, 1992). Educational reform involves more than restructuring however. Educational reform has three component aspects.

The Aspect of Restructuring

The comments of Sheingold, Williams, and Peters and Waterman help us clarify what is meant by restructuring. Restructuring can be said to refer to the changing structure of the organization of education. A structure that is moving from a hierarchical organization to an organization that is open and participatory (Williams, 1992), a system that promotes autonomy and entrepreneurship (Peters & Waterman, 1982); a system in which those who are charged with the responsibility to get the job done have the authority and support to do it (Sheingold, 1991). Summarily stated, current restructuring can be termed those organizational changes that move decision making closer to the site where delivery of services occurs, allowing those that interact directly with the student for example, to make innovative changes to the delivery of instructional services. "The role of the district is crucial. Individual schools can become highly innovative for short periods of time without the district but they cannot stay innovative without district action to establish the conditions for continuous and long-term improvement" (Fullan in Dooley, 1992), p 31. District organizational structure must therefore support empowerment of schools and teachers.

The Aspect of Learner-Centred Environments

Sheingold writes of an emerging consensus about learning and teaching that she terms "active learning/adventurous teaching" (Sheingold, 1991, p. 19). Known also as a constructivist or a learner-centred approach to schooling, the consensus refers to a collection of assumptions that support a learning environment that is less telling and more supporting on the part of the teacher. Traditionally a more authoritative, teacher-centred, didactic approach to education has prevailed in public education. Under this approach, teachers are expected to master a particular discipline, impart that knowledge to students, and measure the success of the transfer of knowledge through some form of comparison against an accepted standard (Collins, 1991). The learner-centred approach is more process-based than knowledge-based, and concentrates on developing skills to interact directly with knowledge rather than receiving knowledge from the intermediary of the teacher. The teacher's role becomes that of a facilitator, providing an environment structured to develop such skills. Students are provided with learning experiences designed to developing lifelong learning skills, critical thinking and problem solving skills, cooperative skills, effective communication skills, and adaptability skills. These skills are thought to be essential to thriving in a rapidly changing economy and society (Mair, 1994).

The Aspect of Integrated Technology

A third component of reform is the increasing application of technology to learning. Unfortunately, research questions directed at educational technology have often posed the same questions as would be posed of the process the technology is purported to replace or automate rather than looking at new processes or goals that are made possible as a result of the technology (Gardner & Salomon, 1986). Technology has made inroads into education though. There exist many isolated examples of technology implementations in schools with varying degrees of success, but there has been little widespread change in the business of education as a result of technology integration (Mecklenburger, 1990). Yet some authors do feel that educational technology will somehow, almost subversively, force change in structure and in teaching and learning. The contention is that since using computers entails active learning, this change in practice will eventually foster a shift in society's beliefs toward a more constructivist view of education (Collins, 1991). Newman disagrees, saying that contrary to what many technology proponents indicate, much of the widespread implementation of computer technology is fully compatible with existing structures. Newman uses the explosive growth of Integrated Learning Systems (ILSs) — systems specifically promoted on their ability to raise standardized test scores — as very strong evidence of educational technology's adaptability to support existing structures (Newman, 1992). These systems automate the traditional imparting of knowledge and testing of the success of the transfer.

If technology is to achieve the influence Collins describes, its use must go beyond the automation of traditional processes as described by Newman. Technology use must foster and support innovative ways of reaching educational goals, both by facilitating restructuring and by facilitating active learning.

Summary of Reform

Levinson speaks of three possible outcomes of an implementation of an innovation: *mutual adaptation* occurs when both the innovation and the organization undergo a change as a result of the innovation, *co-optation* occurs when the innovation is adapted to further the existing structure or purposes of the organization, and *technical implementation* occurs when the innovation is in place, but not fully used or adopted (Levinson, 1990) . It is only through mutual adaptation that technology can effect change in education. The forces of the status quo are substantial in public education. Everyone has experienced public education, so everyone is an expert. Teachers tend to model their approach to teaching after the teaching styles they observed and experienced as students (Planow, Bauder, Carr, & Sarner, 1993). Newman's example of the explosive growth in ILSs, particularly given their costs, is persuasive evidence that Collins may be overly optimistic. In reality technology alone cannot create change. Change is created by people who understand that technology is a tool to be used to further their own personal or organizational advantage (Surgenor, 1992). Collins and Newman are both correct. Specific applications of technology do promote the constructivist's view, while others detract from such an approach. It is likely that Collins refers to applications of technology that are generic in nature and consequently promote divergent thinking, while Newman refers to specific purpose computer assisted instruction applications of technology that promote more convergent thinking on the part of users.

Sheingold puts reform clearly into perspective by tying all three aspects of reform together. Referred to as agendas by Sheingold, she asserts that "the successful transformation of student learning in the 1990s will require the bringing together of three agendas for reform: an emerging consensus about learning and teaching, a movement towards well integrated uses of technology, and the push for restructuring" (Sheingold, 1991, p. 17). Sheingold points out the interdependence of all three aspects of the school reform movement. She contends that no one thrust can succeed without concurrent success of the other two. This is a critical point, for without the concept of interrelatedness of current thrusts in education, we are often left with a sense of competing initiatives. Within Sheingold's framework, we can sit as if on top of a mountain, and see how all these valleys of reform come together. Without her framework, we are in the valleys, responding to individual thrusts and initiatives that don't seem to have any common thread.

The Problem

Accepting Sheingold's framework clearly points out the importance of integrating technology effectively if restructuring of schools and learning environments is to achieve outcomes that are well aligned with the needs of society. Many factors have been identified as influencing the integration of computers and other advanced technologies into the management and delivery of instructional programs (Bohlin & Hunt, 1993), (Kay, 1990), (Spence, 1986), (Marcinkiewicz, 1994). Factors such as educator acceptance, awareness, skills, inservice, technical reliability, instructional support, availability, innovativeness, perceived relevance, locus of control, and educational effects are cited as relevant factors. Consequently many assumptions about the appropriateness of these factors as predictors of successful integration of technology likely exist.

In an ideal world a 'silver bullet' would exist that would be the one thing educators could do to ensure effective integration of technology in education. This 'holy grail' of educational technology does not likely exist. Likely though, what do exist are critical applications of technology that are pivotal in achieving more widespread integration. The concept is similar to the historical influence of Visicalc on the success of the Apple II computer in the 1970s, or the similar influence of PageMaker on the success of the Macintosh in the 1980s (Halfhill, 1994). In both cases these computers were purchased initially for a specific "killer applications" (Halfhill, 1994, p. 50). Once in use though, the computers were found by users to serve many other purposes. These single purpose machines became multi-purpose in the hands of their users.

In education, rather than ensuring the success of a particular product, these 'first step' applications are the ones that successfully break the roadblocks to achieving the will to integrate technology. If the parallel exists, then providing a single-purpose application that gets teachers using computers on a regular basis, and encourages other uses, will eventually result in multiple uses of the computer by these teachers.

Only through use can we expect teachers to provide a meaningful role for technology. Only through use can we expect teachers to develop the understanding and the commitment required to use computers effectively and integrally in instruction. The most significant factor in successfully integrating technology may be commitment on the part of teachers who still control the learning environment (Kay, 1990). The requisite role of technology in current and future schooling is simply rhetoric for teachers who are unfamiliar and unconvinced.

This author contends that above all else, the computer is a communications device. The historical adoption of this view can also be traced to the introduction of desktop publishing programs (DTP) such as PageMaker. "DTP based on Mac technology made the personal computer a legitimate communications device" (Piller, 1994, p. 118). A corollary to this contention is that attractive, easy to use, and well-connected local electronic mail is a pivotal application in establishing an environment where teachers will initially experience successful, relevant, and extremely useful applications of technology without the burden of lengthy training and support. These early and positive experiences communicating with the aid of a computer go beyond mere access to a computer in getting teachers 'over the hump' and on the road to continuous development of the technology using skills, awareness, and attitudes necessary for effective integration of technology.

Electronic mail, even in a jurisdiction with strong support and good access to computers will, in this author's view, significantly influence the attitudes, abilities, level of integration, and innovativeness of professional teachers' experiences with computers.

In addition to all of it's other virtues, electronic mail may be the most powerful inservice tool available.

The purpose of this study then, is to determine the relationship between use of school division electronic mail and increased integration of technology by teachers. The level of integration of computers is considered to be dependent upon computer attitudes, perceived self-competence using computers, and disposition to innovativeness on the part of teachers.

The participants in this study come from two founding school jurisdictions that formed a regional division four months into the school year and approximately three months before the data collection for this study was completed. Jurisdiction Y had a long history of specific central office support for technology while Jurisdiction X had no specific central office support for technology. This factor is expected to be significant in influencing teacher integration of technology and will be addressed to determine if differences actually exist.

Stated definitively, the following problems are being addressed:

Problem 1: To test the relationship between use of electronic mail and teachers' level of integration of computers, as measuring by the expendability of computer use in teaching.

Sub-Problem 1.1: To test for a correlational relationship between use of electronic mail and teachers' level of integration of computers.

Sub-Problem 1.2: To test the relationship between electronic mail use and the level of integration of computers to determine if there is an indication of a predictive relationship.

Problem 2: To test the relationship between use of electronic mail and four predictors of integration of computers identified in the literature:

teachers' affective attitudes towards using computers, teachers' cognitive attitudes towards using computers, teachers' perceived level of self-competence in using computers, and teachers' level of innovativeness.

Problem 3: To test the influence of central office support for technology on teachers' level of integration of computers, teachers' affective attitudes towards using computers, teachers' cognitive attitudes towards using computers, teachers' perceived level of self-competence in using computers, and teachers' level of innovativeness.

Clarification of Terms used in the Problem Statements

Two terms are used in this study when referring to attitudes. The first term is *Affective Attitude.* In this study, *Affective Attitude* is used to define those attitudes that are formed on the basis of feelings associated with using a computer. The second term is *Cognitive Attitude*, which at first may appear to be an oxymoron. In this study, *Cognitive Attitude* is used to define those attitudes that are formed based on cognitive factors, rather than attitudes formed on the basis of affective factors. Specifically, these are attitudes having to do with the teacher's perception of relevance of computers to teaching, learning, and adult lives. The distinction is provided since it may be quite possible for a teacher to have a low affective attitude about computers based on personal experiences that may have been less than positive, but still have a positive cognitive attitude based on knowledge that the use of computers is indeed relevant, in spite of personal experience. Conversely it is possible that a teacher is very favorably disposed to using a computer but considers computers to be irrelevant to teaching and learning.

Perception of self-competence refers to the perception of one's own level of competence in using computers. It is used in this study specifically regarding computer use, and has no relevance or implication beyond this one specific area of competency.

Innovativeness refers to a measure of 'willingness to change'. It does not refer to actual actions taken, or the creation of innovation. For a full explanation see Chapter Two.

The four variables noted in the second problem statement have been identified in the literature as being predictive of computer use. In this study these variables will be referred to as predictor variables.

Delimitations

This study accepts the notion that three aspects of reform acting in synergy will be required to effectively align public education with the emerging needs of society. Of the three, instructional practice, restructuring, and integration of technology, it is technology that is the focus of this study. This study examines one specific application considered to be a pivotal first step in establishing widespread integration of technology, and therefore effective in initiating eventual changes in instructional practices. Other applications of technology may be considered to be pivotal as well. The experience of the author has led to the hypothesis that easy-to-use, graphic, and locally well-connected electronic mail is a powerful Trojan Horse that will promote technology integration. For this reason, this study is restricted to this one application.

The analogy of a Trojan Horse is far from perfect. The term Trojan Horse has the historical context of the Greeks using a wooden horse filled with soldiers to fool the Trojans into opening the gates to the city of Troy. In the area of technology integration, there is no intent to fool anyone. The analogy is provided so that the role of electronic mail is seen in this study as a device to circumvent the many barriers to teachers using technology. These barriers are manifest in lack of time and resources for inservice, lack of a clearly understood benefit by non-using teachers, and a lack of clearly identifiable 'first step' activities. It is in the role of eliminating or circumventing these barriers that the analogy to a Trojan Horse is drawn.

Electronic mail is a far more useful tool than simply an inservice tool. It is a valuable tool for professional and other communications. Electronic mail may also be an effective restructuring tool, since it may promote the collapsing of hierarchical structures by circumventing traditional hierarchical communications patterns and promoting lateral collaboration and communication. In this study though, its role is delimited by its effect on the identified variables.

The worth of a constructivist approach to teaching and learning is not being considered here. Similarly, the nature of restructuring required to achieve an effective synergy is not a component of this work other than the cursory treatment provided in this chapter. Inclusion of all three components in the introduction to this work was done to set the global context within which this study is being conducted.

This study deals with the experiences, perceptions, and instructional practices of teachers in a recently regionalized Alberta school division. This division was formed when the Boards of Education of two neighbouring counties amalgamated. With a return rate of 93% this study may be considered the study of a population with respect to the participating school division. Generalizing these results for other Alberta teachers is discussed under limitations below.

It is important to distinguish between the generic concept of electronic mail and the specific attributes of the mail system that is central to this study. Some mail systems are cryptic, cumbersome, unattractive, and do not provide connections to those people with whom a teacher might interact with frequently on a day-to-day basis. This study is based on the use of QuickMail in a local school district mail system. QuickMail is highly regarded in the computer industry, receiving a 4.5 out of 5 mouse rating by a leading industry periodical (Zilber, 1992). The software exhibits the attributes of an attractive interface, is generally thought to excel at ease of use, and in the jurisdictions studied, provides connections to many of the people with whom a teacher in the district would interact with on a frequent basis.

Limitations

Two potential limitations have been addressed in the data collection and analysis. Firstly, it could be argued that it is access to a computer in the classroom that is influential, not electronic mail. To distinguish between the two factors, teachers will be asked to indicate the ease with which they can access a computer at school. A binary variable indicating whether or not a computer is present in the teacher's school workspace (classroom or office) will be included in the correlation matrix. Secondly, it could also be argued that having a computer at home is the influential predictor. This will be addressed by collecting this data and including a second binary variable in the correlation matrix.

Teacher-specific statistics on use of the district mail system were collected from the logs of district mail servers over a one month period. These logs were used to represent typical mail traffic. It could be argued that frequency of use is not as important as the fact that the system is used. To address this limitation, a second variable will be considered in the analysis. This variable will simply categorize teachers as users or non-users based on a self-report item. The two variables allow use of the mail system to be addressed as a separate variable from frequency of use of the mail system.

The teachers participating in this study are considered to be representative of typical Alberta teachers. When considering participants in this study to be a sample of Alberta teachers, the reader is cautioned that the access to and support for technology on the part of teachers within founding Jurisdiction Y is likely to be greater than average for Alberta teachers. There may be a concern that this emphasis on technology may have drawn technology-oriented teachers to Jurisdiction Y, and consequently that these teachers may not form a representative sample of Alberta teachers. This concern is tempered by the fact that two founding jurisdictions are similar in location and size, and the fact that a low turnover rate and relatively tight job market for teachers in Alberta over the past several years has prevailed.

Finally, Alberta public education is currently undergoing a major restructuring process that has been initiated by the provincial government. This process has created a highly charged environment that is dramatically different from that of any time in recent public education history. Regionalization and a move to site-based decision making may have dramatically changed the culture of some participating schools. This does present a unique opportunity to study two groups of teachers with significantly different technology histories, but the status quo has definitely been disrupted. At this point the changes directed by Alberta Education have impacted on governance more than classroom practice, therefore it is likely too early in the change process to suggest that it has had any effect on the results of this study.

Conclusions

This chapter has set the direction for this study by providing a context within which the research topic was chosen, and by defining the research problem. Delimitations and limitations are included to clearly define the scope of the research. In Chapter Two, a review of the relevant literature will discuss previous work in the areas of electronic mail, computer integration, and predictors of computer integration. Chapter Three will present the methodology used to collect and analyze the data needed to address the research problems stated above. Chapter Four will present the results of the data collection and analysis. Chapter Five will provide an explanation of how this author interprets the results obtained in this study, and will also provide recommendations for practitioners and researchers.

Chapter II

Review of the Literature

Introduction

Literature reviewed for this study generally falls into three categories: firstly, literature reviewed to explore the global context of educational reform, within which this study's significance is defined; secondly, literature reviewed to directly explore previous work in the areas of electronic mail, teacher adoption of technology, computer literacy, computer attitudes, and innovativeness; thirdly, literature dealing specifically with the methodology being utilized. The first category is presented in chapter one as the stage for this research is being set, the second category will be cited exclusively in chapter two, and the third category will be cited in both chapter two and chapter three as the methodology is presented.

Chapter two then, will not revisit the literature appropriate for setting the context, but will be restricted to literature directly respecting the formation of the problem statement and previous research respecting similar problems.

Introducing the Problem

There is an abundance of research focusing on integration of technology into the instructional setting. Previous researchers have worked to identify factors that contribute to or detract from the adoption of technology. Studies have ranged from examination of specific applications of technology to the more generic use of technology. This author examined factors affecting the adoption of word processing for writing and identified access to equipment, keyboarding skills, teacher awareness, and educational effects as being important factors influencing adoption of technology for writing (Spence, 1986). Others have explored the concepts of commitment, gender, perceptions of self-competence, age, locus of control, perceived relevance, innovativeness, experience, and level of use on the part of teachers as being key ingredients to integration of technology (Kay, 1990), (Marcinkiewicz, 1994), (Bohlin & Hunt, 1993). Several of these factors have been shown to have significant positive relationships with adoption of technology. None of these previous studies deal with the concept of pivotal applications of technology that may affect factors shown to have significant positive influences on technology adoption. This study is original in nature since it directly explores the relationship between use of electronic mail, teacher level of integration of computers, and factors previously shown to be predictive of integrated use of computers. These include cognitive and effective attitudes, perceptions of self-competence, and innovativeness.

Use of Electronic Mail

A search of the literature produced no previous research specifically investigating the relationship between use of electronic mail and the broader adoption of computers for instruction. Works dealing with electronic mail are few in proportion to works dealing with other topics respecting technology in education. Of these, distance is a common thread, but references to local electronic mail systems are lacking. Electronic mail is often considered to be a sub-function of Computer Mediated Communications (CMC). Computer mediated communications consists of electronic mail, computer-conferencing (uni or multi-media), and access to remote data bases (Mason, 1990). Examples of these works deal with CMC and distance education (Dhariwal, 1991), home/school communication (Bauch, 1989), or the nature of electronic communication in a distance education setting (Mason, 1990). Other, less academic works, describe perceived benefits to be derived from adopting electronic communications networks (Wishnietsky, 1991).

An ERIC keyword search of "electronic mail" produced 996 results. A keyword search of "staff development" produced 6117 results. When combined however, the two searches produced only 21 results. Again, distance education was a common thread. References to staff development cited ways of developing skills in using electronic mail rather than the broader aspect of using electronic mail to achieve widespread technology integration.

Kaye and Mason (1990) postulate that certain changes are inherent in the distance learning process as a result of the adoption of CMC. To achieve a new paradigm of distance education Kaye and Mason cite the need to update curriculum to reflect a more process-oriented approach to learning, the inevitable collapsing of the traditional hierarchy and resulting changing of student and teacher roles as a result of lateral communications facilitated by CMC, and the need for faculty (and student) competence in using CMC tools. These three aspects respectively parallel the emerging consensus on teaching and learning, restructuring, and the use of technology discussed in chapter one.

The work of Kaye and Mason suggests that the distinction between distance education and place-based education will continue to blur. Traditionally distance has been seen to be a limiting factor in distance education. Adoption of CMC has been driven by a desire to overcome distance. Its use does not completely overcome distance however, since it is only partially a substitute for telephone conversation, face-to-face communication, postal letters and print materials. Use of CMC actually tends to increase the desire for other means of communications (Mason, 1990). Electronic mail and other aspects of CMC have advantages not inherent in other forms of communications and are more complimentary than substitutive in nature. For example, teachers within the same school would not normally write a postal letter to communicate. Electronic mail makes such asynchronous communication possible and frequent. Similarly teachers would not normally be able to communicate synchronously while classes are in session unless they are in very close proximity within the school. While electronic mail is essentially asynchronous in nature, the rapidity of local-area-network (LAN) electronic mail delivery provides an opportunity for teachers to engage in communication approaching a synchronous nature while classes are in session. Many LAN based systems (including

QuickMail) actually have a synchronous “chat” feature, making it easy to communicate across the network during class sessions.

The unique advantages of electronic communication discovered by its use in distance education suggest that the general lack of electronic mail use in place-based education is a weakness of education in a traditional setting.

Level of Use of Computers

Use of computers has generally been dealt with in two ways in the literature. One approach looks at the factors such as years of experience, frequency of use, hours of use, and type of applications being used (Kay, 1988), (Bohlin & Hunt, 1993). The second approach is more concerned with the level of use, or the degree of integrated use, rather than simply the amount of use.

A popular model of use in Alberta educational technology circles describes the operation, application, and integration level (Spence, 1987). The operation level consists of mastering the basic skills required to use a computer. This includes generic skills such as turning it on, operating the keyboard and mouse, and saving and retrieving files. The application level is specific to mastering the skills required to operate various applications such as word processors, spreadsheets, or photo editing software. The integration level is achieved when the outcome of the work becomes the focus. At the integration level, the user is familiar with operation skills and the specific application skills required for the software being used, and is therefore directing most or all effort towards utilizing these known skills to complete the work at hand. For example, using a spreadsheet at the integration level, the user is concerned with analyzing data rather than developing application skills. The computer and software provide the means to edit and manipulate the data. These levels are generally thought to be achieved sequentially, but recursion occurs when new applications are utilized or new versions of known applications are released. This model is not restricted to instructional use or educational users, but is a generic model of the development of computer using skills.

A second model, specific to instructional use by teachers, defines three levels of integration: non-use, utilization, and integration (Marcinkiewicz, 1994). This model does not distinguish between operation and application levels of use, and is considered to be sequential. Marcinkiewicz developed the Levels of Use Assessment (LUA) to assign teachers to one of three levels of computer use. Absence of computer use of any kind for teaching is the criteria for assignment at level one (non-use). The second and third levels represent progressive levels of integration of computers in teaching, with expendability of the computer for teaching being the critical attribute. If use of the computer is considered by the teacher to be expendable, then the teacher is assigned to level two (utilization); if the computer is considered by the teacher to be indispensable, then the teacher is assigned to level three (integration). Those at level three then, consider the computer to be non-expendable, those at level two utilize computers but consider them to be expendable, and those at level one do not yet use computers for teaching.

Marcinkiewicz's model is based on the model of instructional transformation (Rieber & Welliver, 1989). Rieber and Welliver devised a five-level sequential model consisting of familiarization, utilization, integration, reorientation, and evolution. This sequential model starts with teachers becoming familiar with computers (familiarization), beginning to use them in instruction (utilization), then having the computer assume a critical role in instruction (integration). It is at this level that teachers become aware of a change in their own personal role, and begin to restructure the learning environment to fine-tune the computer-teacher-student relationship (reorientation). The fifth level (evolution) is achieved when the teacher remains sensitive to, prepared for, and able to adapt to, change. The LUA roughly corresponds to three early levels of the sequential five-level model of instructional transformation developed by Rieber and Welliver (1989). The discrepancy is at the first level. The LUA requires non-use of computers for assignment to this level, while the model of instructional transformation requires early familiarization with computers.

Marcinkiewicz (1994) was able to categorically access teacher's computer use and identify self-competence and innovativeness as personal variables that contribute to a teacher's level of integration.

Predictor Variables Identified in the Literature

Computer Attitudes

The origins of attitudes regarding computers can be traced to the affective and the cognitive domains. The affective domain deals with participants' feelings towards using computers, while the cognitive domain deals with participants' perceptions of the relevance of using computers. Bohlin and Hunt (1993) explored entry attitudes of students enrolling in educational computing courses and found general agreement on the usefulness of being able to use computers in today's society. They also reported positive attitudes towards using computers, but many of these future teachers did not feel they needed a firm mastery of these skills for their careers. Bohlin and Hunt also reported a significant positive correlation between previous experience and positive attitudes towards using computers. Other authors attach similar significance to attitude with respect to use of computers (Chapline & Turkel, 1986), (Loyd & Gressard, 1984), (Harmon, 1986), (Griswold, 1985), (Gressard & Loyd, 1985). Unique among these works however, is the work of Kay (1988), who theorized that cognitive and affective attitudes (among other factors) are predictors of a more important factor influencing adoption of computers: commitment. Both cognitive and affective attitudes were shown by Kay to be significant predictors of teacher commitment to the use of computers. Marcinkiewicz (1994) also explored factors influencing teacher use of computers in the classroom. Although attitude was not specifically identified as a variable, Marcinkiewicz asked respondents to rate the perceived relevance of using computers on a single 7-point scale. This cognitive attitude towards computer use was not shown to be predictive of the level of computer use by teachers. There appears then, to be mixed support in the literature to suggest that positive attitudes towards computers contributes to their adoption in instructional settings.

Perceived Self-Competence

There is abundant reference in the literature to computer literacy. Some of these works involve the development of elaborate instruments to measure this variable (Kay, 1993), (Bitter & Davis, 1985), (Gabriel, 1985a), (Cheng, Plake, & Stevens, 1985). Others attempt to define what computer literacy is in the first place (Johnson, Anderson, Hansen, & Klassen, 1980), (Levin, 1983), (Longstreet & Sorant, 1985).

Interest in the concept of "Computer Literacy" reached a peek in the mid 1980's. The Alberta Education Curriculum Branch *Computers in Elementary Education Committee* (consisting of practicing educators and Alberta Education staff) defined computer literacy as "those skills needed to use the computer as a tool" (Alberta Education, 1987). This author's response to the continued unsuccessful effort to define computer literacy led to abandonment of the effort as an unprofitable venture (Spence, 1987). Although many researchers have used various measures of computer literacy, the continued debate as to the meaning of the term suggests that it is likely an unreliable variable. The generic nature of the computer and rapid changes in software abilities would appear to be the reason for the difficulty in defining competence.

Absent from all measures of computer literacy is data on how the user interacts with the computer, the context within which the computer is used, and the goals or needs of the user (Kay, 1994). In his 1994 study, Marcinkiewicz (1994) ignored the concept of computer literacy and took a much more direct approach that may indirectly address the issues raised by Kay. Rather than attempting to measure competence, Marcinkiewicz asked participants to self-report their competence. Although the actual level of competence of a respondent may vary considerably from that reported, a given user's perception of competence likely parallels that user's level of successful integration of computers to meet personal needs or objectives. Marcinkiewicz was able to show that perceived self-competence using computers was predictive of the level of computer use in the classroom. While the link between actual competence and self-perception of competence may be suspect, the link between self-perception of competence and adoption in the classroom is evident from the Marcinkiewicz study. His results suggest that increasing a teacher's perception of self-competence using computers may increase the likelihood of adoption in the classroom. What appears to be more critical here is perception of literacy rather than actual literacy. Self-perception may rarely match reality with respect to computer literacy, but likely it is perception of competence, much more so than actual competence, that will carry teachers forward to new frontiers in the use of technology in the learning environment.

Innovativeness

Innovativeness shares an intimate relationship with change. Some authors define innovativeness as a willingness to change (Hurt, Joseph, & Cook, 1977). Others take a behavioral approach and define innovativeness as the degree to which individuals adopt innovations relative to others within the same social system (Rogers & Shoemaker, 1971). Neither would appear to define the innovator as one who creates change.

At the other end of the scale, resistance to use of computers has been speculated as being caused by people experiencing resistance to change, fear of loss of status, ignorance of the potential of computers, fear of replacing familiar procedures with unfamiliar ones, and fear of loss of hard-learned skills (Nickerson, 1981).

Using a shortened version of The Innovativeness Scale (Hurt, et al., 1977), Marcinkiewicz (1994) was able to show significant correlation between "willingness to change" and level of computer integration. Whether innovativeness is an innate trait or an acquired disposition is not clear.

Conclusions

Research regarding teacher adoption of technology continues to evolve in parallel with the technology itself. For academic reasons, understanding of those factors that contribute to or detract from successful integration of technology is sought. For more pragmatic reasons, identification of the subset of factors that can be manipulated in such a way as to promote more rapid and relevant integration of technology is the goal.

This study draws on previous works aimed at identifying influential and manipulatable factors with the intent to test the relationship between these factors and the use of a specific application of technology. Factors that the research has shown to have little or no effect on computer use are not included. Innovativeness, perception of self-competence, and attitudes have been shown to be predictive of integrated use of computers. The relationship between electronic mail usage and these factors has not been investigated.

Chapter III

Methodology

Introduction

This study is primarily a descriptive study that explores the relationship between electronic mail, integration of computers, and four factors identified in the research as being predictive of the level of integration of computers by teachers. This chapter will introduce the electronic mail variables, the level of use variables, and the variables based on predictive factors identified in the literature. The methodology for data collection including the *Computer Use Questionnaire* instrument (Appendix A), and the methodology for analysis will also be presented.

Variables

Electronic Mail

Two variables are used to represent participant use of electronic mail. The first variable, *Use of District Mail*, is a two-position nominal variable that records whether or not the participant uses electronic mail. Since it is possible to be a user of the district electronic mail system without having a personal ID, direct inquiry was chosen as the method of obtaining this data (Appendix A, Section 4, item 34). The second mail variable, *Frequency of Use of District Mail*, measures the frequency of use by collecting two sub variables: the total number of messages sent and the total number of messages received within a specified one-month period (March, 1995). These two sub-variables are totaled to obtain a total usage value for the month. Participants who send mail and who have usage amounts other than zero are entirely contained within Jurisdiction Y because no teachers within Jurisdiction X yet had access to the school division mail network when the data was collected.

System logs create an entry every time a message is sent. The entry contains the date, time, subject, sender, and receiver. Individual frequency of use for March, 1995, was the only information collected from these logs.

Level of Use of Computers (Expendability)

For the purposes of this study, the level of expendability of computers is based on the model of instructional transformation described by Rieber and Welliver (1989). Computer use was categorized using the LUA measure (Marcinkiewicz, 1995b). Using the LUA measure (Appendix A, Section 3), teachers are assigned to one of three progressive levels of use. Non-use of computers was the criteria for assignment at level one. Second and third level assignment required use of computers, with the distinction being the teacher's perception of expendability of use. If the computer was considered to be expendable, the teacher was assigned to level two (utilization); if the computer was considered to be indispensable, the teacher was assigned to level three (integration). The LUA measure produces ordinal data from which two variables are determined. The first variable, *LCU*, is the three level distribution provided directly by the LUA measure. The second variable, *Integration*, is a binary variable reflecting the attribute of expendability for computer users only. Computer using teachers fall into one of two progressive levels with respect to the variable *Integration*. Either the use of the computer is not integrated, or it is integrated.

Most statisticians would argue that LUA data should not be rendered as continuous over all three categories because doing so depends upon an assumption that the category 'utilization' is midway between 'non-use' and 'integration' (Doss, 1995). The developer of the instrument agrees that technically the data should not be treated as continuous, but that doing so is justified when the work is exploratory in nature, and when the goal is to discover if there is any indication of a relationship. Consequently

Marcinkiewicz treated the data as continuous for the correlational analysis in his 1994 study (Marcinkiewicz, 1995a).

Non-use was simply reported by teachers (Appendix A, Section 3, item 25). For computer users, the LUA makes pair-wise comparisons (Appendix A, Section 3, items 26-29). Levels of utilization and integration are each represented by two items. Each item is alternately paired with an item from the other level and the respondent is forced to make a choice between the two. With two items from each level being paired with an item from the other level four permutations, or forced choices, resulted. Since the two usage levels were mutually exclusive and exhaustive, responses of those using computers were anticipated to follow one of two patterns: utilization or integration. The utilization pattern results from choosing the utilization item in each of the four forced-choice pairs while the integration pattern results from choosing the integration item from each of the four forced-choice pairs. Failure of a respondent to follow one of the two patterns indicated inconsistent responses. The dichotomous nature of these forced choices was expected to result in a number of inconsistent responses. This prediction is based on the likely unwillingness of some participants to commit to one category or the other as indicated during this study's pilot of the instrument.

To help understand the expected inconsistent responses Marcinkiewicz (1994) utilized an additional item called the Effect of Removal Scale (ERS). This item asked teachers to choose one of three statements that best described the estimated effect of removing computers from schools on their individual teaching (Appendix A, Section 4, item 37). The choices were no effect, little effect, or significant effect. The LUA uses the strong adjectives 'indispensable' and 'critical' to describe the role of the computer. The *Effect of Removal* measure uses milder terms by asking whether removal of all computers would have a 'significant effect' on teaching.

Data from the ERS provides an alternative measure of the level of integration that allows for the reluctance of respondents to be forced into one of the two categories allowed by the LUA. Both measures can be used to yield binary variables for expendability. In the case of this study, the variable derived from the ERS is based on whether or not removal of computers would have a significant effect on teaching for computer users.

Predictor Variables from the Literature

Computer Attitudes

Computer attitudes are represented by two variables. The first variable deals with *Affective Attitudes* towards computers, while the second variable deals with *Cognitive Attitudes* towards computers. For the *Affective Attitudes* variable participants were asked to respond to a number of semantic differential pairs designed to determine how each participant feels about using a computer. The instrument used for this variable was based on the work of Kay (1988) and consists of 10 semantic differential pairs on a seven point scale (Appendix A, Section 1). Kay's original instrument consisted of 20 items to measure affective attitudes and 14 Likert scale items to measure cognitive attitudes. The Affective Attitudes Scale was shortened to 10 items for two reasons. The first was to expedite completion of the questionnaire. In addition, this author felt that the degree of redundancy in the original instrument was unacceptable and would not contribute to accurately measuring this variable. Expert opinion was sought on this point and agreement was confirmed (Doss, 1995). Kay (1988) was also interested in measuring cognitive attitudes. This study takes a different approach than that taken by Kay, relying instead, on a more direct inquiry of perceived relevance of using computers.

The second variable, *Cognitive Attitudes* towards computers, refers to teachers' perception of the relevance of using computers in teaching, learning, and students' adult lives. The instrument is based on the Perceived Relevance scale developed by Marcinkiewicz (1994). Marcinkiewicz used a single 7-point Likert item that asked teachers to indicate their level of agreement with the statement "I believe that the use of computers is relevant to teaching". For this study, a second item was added that asked teachers to indicate their level of agreement with the statement "I believe that the use of computers is relevant to student learning", and a third item was added that asked teachers to indicate their level of agreement with the statement "I believe that the use of computers is relevant to my students' adult lives". Together the three items make up the measure for the *Cognitive Attitudes* variable (Appendix A, Section 2, items 21-23).

Perceived self-competence using computers

Perceived self-competence was reported in a similar fashion to perceived relevance. In the same 1994 study, Marcinkiewicz used a single 7-point Likert item that asked teachers to indicate their level of agreement with the statement "I believe that I am capable of using microcomputers competently in teaching". Marcinkiewicz was very specific about using computers in teaching. For this study, the reference to teaching was deleted in favor of a self-report on general competence using computers. Teachers were asked to indicate their level of agreement with the statement "I believe that I am capable of using a computer competently" on a 7-point Likert scale (Appendix A, Section 2, item 24). The variable *Self-Competence* is derived from this measure.

Innovativeness

For the purposes of this study, innovativeness is viewed as a disposition towards acceptance of innovation, or a willingness to change (Hurt, et al., 1977). Others view innovativeness as the degree to which one is an early adopter of an innovation relative to one's peers (Rogers & Shoemaker, 1971). The Innovativeness Scale was developed to capture "willingness to change" (Hurt, et al., 1977). The original instrument consisted of 20 Likert-type items with a 7-point scale. Marcinkiewicz (1995) shortened the scale to 10 items while maintaining a reproducibility factor of r=.92. The shortened version of the scale was utilized to expedite completion of the questionnaire (Appendix A, Section 2, items 11-20). The variable *Innovativeness* is derived from this measure.

Categorizing and Other Variables

To isolate known differences between sub-groups, two binary variables are included in the data. Participants are identified according to whether they work within a school from founding Jurisdiction X or Y with *Jurisdiction*, and whether or not they have a computer in their classroom or office (at their workspace) with *Computer at Workspace*.

Several other demographic variables are included in this study. To test the relationship of having a computer at home, a binary variable, *Home Computer*, is included on the instrument (Appendix A, Section 4, item 32). Participants are asked about their personal experience with electronic mail (Appendix A, Section 4, item 30), whether or not they have easy access to a computer at school (Appendix A, Section 4, item 36), whether or not they have heard of the district system (Appendix A, Section 4, item 33), whether or not they use the district system (Appendix A, Section 4, item 34), and if so, their estimate of the amount of use of the district system (Appendix A, Section 4, item 35). These items do not specifically address any of the problem statements, but are included to further explain the results attained.

Instrument

The *Computer Use Questionnaire* (Appendix A) developed for this study is adapted from instruments used by Marcinkiewicz (1994 & 1995) and by Kay (1988). Some items were deleted from each of these instruments when they were not considered relevant to this study. Additional items were added to address issues not addressed within either of the two original instruments.

Data has been collected from school division server logs and from school division demographic files. Use of electronic mail other than the school division mail system was obtained from a single item on the instrument (Appendix A, Section 4, item 31). Marcinkiewicz's Levels of Computer Use is used in it's original form without modification (Appendix A, Section 3). The Innovativeness Scale (Hurt, et al., 1977) is used as shortened by Marcinkiewicz (1995), with wording of some items slightly modified by the author to enhance clarity (Appendix A, Section 2, items 11-20). The Assessment of Self-Competence (Marcinkiewicz, 1995b) was slightly modified to reflect a more generic measure of computer competence rather than a specific computer competence directly related to teaching (Appendix A, Section 2, item 24). The Assessment of Perceived Relevance (Marcinkiewicz, 1995b) was expanded to include relevance to student learning, relevance to student adult life, and the original relevance to teaching (Appendix A, Section 2, items 21-23). The Affective Attitudes Scale (Kay, 1988) has been shortened to expedite completion and reduce redundancy (Appendix A, Section 1).

A summary of data collection methods is presented in Table 1.

Table 1: Data Collection Methods

Instrument	Number of Items	Data Gathered	Variable Addressed
Levels of Use Assessment	5	levels of use of computers	LCU Integration LCU 4-12
Innovativeness Scales	10	willingness to change	Innovativeness
Affective Attitudes Scale	10	affective attitudes towards computers	Affective Attitudes
Assessment of Perceived Relevance	3	teacher's perceived relevance of the use of computer technology by themselves and by their students	Cognitive Attitudes
Assessment of Self-Competence	1	self-competence with respect to using computers	Self-Competence
E-Mail Usage Scale	1	non-knowledge, non-use, use of other mail systems, use of school division mail system	Use of Electronic Mail
Effect of Removal Scale	1	teacher's perception of how removal of computers would affect the way they teach	Effect of Removal
Access to Computer Measure	1	teacher's access to a computer	Computer at Workspace
Computer at Home Measure	1	presence of a computer in the teacher's home	Home Computer
Division Server Logs	n/a	use and frequency of use of division mail system	Frequency of Use of Electronic Mail
Division Personnel Records	n/a	founding jurisdiction, gender	Demographic Variables Jurisdiction

In summary, the Computer *Use Questionnaire* contains the following four sections:

Section one consists of the ten 7-point semantic differential scale items that make up the Affective Attitudes Scale.

Section two consists of fourteen 7-point Likert items. The first 10 are the Innovativeness scale, the next three are the Perceived Relevance Scale, and the last one is the Assessment of Self-Competence.

Section three consists of the five items that make up the Levels of Use Assessment (LUA). The first item asks the participant if they are a computer user. If the answer to this question is no, the participant is directed to section four. If the answer is yes, the participant is directed to the remaining four items that constitute the forced-choice pairs.

Section four consists of nine items. The first item is the Electronic Mail Usage Scale. The second item determines if the participant has an e-mail ID other than on the district system. The third item is the Computer at Home Measure. The fourth item tests awareness of the districts mail system. The fifth item asks participants to indicate whether or not they use the district system. The sixth item asks positive respondents to the fifth item to estimate their frequency of use. The seventh item is the Access to a Computer Scale. The eighth item is the Effect of Removal Scale. The ninth item provides participants with an opportunity to make written comments on any aspect of the study. These comments will be used to aid in explanation of results.

Table 2 summarizes the structure of each section of the *Computer Use Questionnaire*.

Table 2: The Computer Use Questionnaire

Sec	Response Type	Scale	Item #	Data Gathered	Variable Addressed
1	Sem/Diff (7)	Affective Attitudes Scale	1–10	affective attitudes of teachers towards computer use	Affective Attitudes
2	Likert (7)	Innovativeness Scale	11–20	willingness to change	Innovativeness
	Likert (7)	Perceived Relevance Scale	21–23	relevance of using computers for teaching, learning, and student future	Cognitive Attitudes
	Likert (7)	Assessment of Self-Competence	24	teachers belief of personal competence using a computer	Self-Competence
3	Forced Pair	Levels of Use Assessment	25–29	membership in the non-use, utilization, or integration group	LCU Integration LCU 4-12
4	self-report category	Electronic Mail Use Scale	30	knowledge and use of electronic mail	Level of Awareness of Electronic Mail
	Forced Pair	Existence of ID on Another System	31	access to e-mail outside of the district system	Access to Other Mail System
	Forced Pair	Computer at home Measure	32	existence of a computer in the teacher's home	Home Computer
	Forced Pair	Heard of District System	33	awareness of the district system	Awareness of District System
	Forced Pair	Use District System	34	use of the district system	Use of District Mail
	self-report category	Perception of Frequency of Use Scale	35	perceived frequency of use of the district mail system	Frequency of Use of District Mail
	self-report category	Access to a Computer Measure	36	ease with which the teacher can access a computer	Computer at Workspace
	forced three item choice	Effect of Removal Scale	37	expendability of the computer	Effect of Removal
	open -ended	n/a	38	qualitative comments	n/a

Data Collection

A master file was created that assigned a participant number for each potential participant. This number was used to label instrument envelopes so that follow-up could be done to ensure sufficient participation. It was also used to disassociate personal identification from the data obtained from personnel records.

School Principals in division schools were asked to distribute *The Computer Use Questionnaire* to all professional staff. Participants were instructed to seal their completed surveys in the provided numbered envelope and to return them to the school office for collection and transport to the investigator. A deadline of approximately one week was set for the return of completed instruments.

Once the one week deadline had passed, participants were contacted by telephone, in person, or through their school principal and asked to consider completing the questionnaire. If during this contact, an individual indicated that they did not wish to participate, "declined to participate" was recorded for this response.

Information from participant personnel records and mail system logs was independently entered into a computer data file. Participant names were replaced with participant numbers in this data file once it was completed. At this point, all files that associated participant names with participant numbers including the master file, were destroyed. Once the link between name and number had been destroyed, envelopes were opened and participant responses were entered into the data file. Opening of the envelopes and response entry was done by a research assistant in the absence of the researcher. After the survey response data was entered, the envelopes were destroyed and the participant numbers were removed from all data files.

Analysis Procedure

Descriptive statistics including histograms and frequency distribution tables were generated for each item to provide an overall picture of the nature of the data (Appendix C).

Raw data scores were then translated into scale scores where appropriate. Some scale items were reflected so that in all cases a higher score indicated a higher measure of the variable being considered. For example, the semantic differential pairs in the Affective Attitudes Scale alternated between positive and negative adjectives on the left.

The item scores were reflected so that scores on the positive adjective side of the scale always indicated a higher score.

Descriptive statistics for all variables were then generated. Frequency distributions for all categorical variables were generated, as was a correlational matrix including all variables.

A stepwise multiple regression was performed using *LCU* as the dependent variable and *Cognitive Attitudes, Affective Attitudes, Self-Competence, Innovativeness, Use of District Mail,* and *Frequency of Use of District Mail,* as predictor variables. The purpose of the regression was to determine if there was an indication of a predictive role for electronic mail.

To further clarify the role of electronic mail, each computer using sub-group determined by the LUA (utilization and integration level users) was studied. Utilization level users were subdivided based on use of e-mail. Single tailed t-tests were performed that compared the means of e-mail users with e-mail non-users for each of *Cognitive Attitudes, Affective Attitudes, Self-Competence, and Innovativeness.* The same procedure was followed for integration level computer users. Written comments made by teachers in each group were also examined.

To address the study's third problem, the data was split by founding jurisdiction, and the means on all level of use and predictor variables were calculated. Jurisdiction Y means were expected to be higher than Jurisdiction X means. Single tailed t-test were conducted to test for significant differences.

The statistical software package StatView 4.1 from Abacus Concepts was employed for all statistical procedures (Gagnon, Haycock, & Roth, 1994).

Sample

The school division employs 414 professional teachers in 22 open-attendance schools. Teachers working at schools within founding Jurisdiction X numbered 169 (40.8%), while teachers working at schools within founding Jurisdiction Y numbered 245 (59.2%). All teachers in these schools were asked to participate. The schools vary in grade levels taught with some offering instruction only to a specific division such as primary grades, upper elementary grades, junior high grades, or high school grades, while others offer instruction to multiple divisions such as from kindergarten to grade 12. Table 3 summarizes the jurisdiction breakdown of teachers asked to participate. Chapter Four opens with a complete description of the participating sample.

Table 3: Jurisdiction Breakdown of Teachers Asked to Participate

Asked to Participate	Number	Percent
Jurisdiction X	169	40.8
Jurisdiction Y	245	59.2
Total	414	100

Ethical Consideration

Extensive efforts were taken to ensure that the data collected in this study remains confidential. Other than the investigator and a research assistant, school division personnel did not and will not have access to the raw data. Any direct ability to identify individuals was destroyed prior to the analysis of the instrument. In addition to University of Alberta regulations regarding ethics, there are three other reasons for providing this assurance of confidentiality. First, several surveys have been administered to Jurisdiction Y teachers in the past few years which, although confidential in nature, provided information that could be used to identify the respondent. For example, a respondent who teaches grade five in school A could easily be identified if there were only one grade five class in school A. For this reason grade level data was not collected even though it was readily available. Second, the nature of the investigator's position as a central office administrator may affect the results if the respondent was not convinced of the confidentiality of their responses. Third, self-measures are susceptible to bias when reporting "sensitive" behaviors such as those involving social stigmas or illegal activities (Edwards, 1957), but self-measures involving non-sensitive activities tend to be quite accurate (Ajzen, 1988; Parry & Crossley, 1950; Pomazal & Jaccard, 1976). The study intentionally does not deal with particularly sensitive information. Regardless, the reader may consider some of the data to be sensitive and susceptible to bias. Kay argues that ability to use computers could be deemed socially desirable, but that complete confidentiality of responses to a survey will negate any risk of bias (Kay, 1993).

Follow-up Data Collection and Analysis Modifications

Follow-up Data Collection

After the data had been analyzed, the results did reveal the expected relationship between use of electronic mail and computer use, but the relationship was unclear. A follow-up data collection was done to clarify the pattern of the existing data. All teachers using the district mail system (n=124) were asked four yes/no response questions as follows:

1. Did you use a computer before you got a QuickMail ID?
2. Do you use a computer more now that you have a QuickMail ID?
3. Do you feel QuickMail was helpful in increasing you level of competence in using a computer?
4. Do you think all teachers should have a QuickMail ID?

Since the ability to associate respondents with responses in the first data set had previously been destroyed, it was not possible to merge the new data with the existing data. A copy of the instrument used for this collection is shown in Appendix B.

Analysis Procedure Modifications

As expected, several teachers did not follow a consistent pattern when completing the LUA, but the number is unacceptably high (84). This raised concerns that the LUA was not providing an effective way of measuring the level of use of computers by these teachers. A technique of applying a finer scale to the data obtained from the LUA is utilized in this study to help understand inconsistent responses. This third variable derived from the raw data of the LUA is termed *LCU 4-12*.

LCU 4-12 is obtained by assigning a value of one to each response in the forced-pair choices that represents utilization, assigning a value of three to each choice that represents integration, and assigning a value of two to incompleted forced-pair choices. Only computer users are included in the determination of this variable, and only those computer users that completed some of the forced-pair choices. The value of two represents a best-guess as to where the participant response belongs between the values of one and three on the incompleted items. Re-scaling the LUA data in this fashion will allow the inclusion of respondents that completed the forced pair section of the LUA but would normally be excluded from analysis due to failure to follow one of the prescribed patterns. This re-scaled variable provides a finer interval variable over a range of nine values and allows for the inclusion of the maximum number of respondents in the analysis.

The *LCU 4-12* variable is included in the correlation matrix along with the original variables derived from the LUA. It is also used in a second multiple regression as the level of use variable.

Conclusions

The procedures and analysis techniques presented here are designed to ensure several factors are addressed. In particular, confidentiality is safeguarded, participation remains optional, and statistical procedures are chosen to ensure that only reliable results are reported. The results of the above data collection and analysis are presented in the next chapter, Chapter Four. Chapter Five provides discussion and implications for the results.

Chapter IV

Presentation of Results

Introduction

In addition to the introduction and conclusion, this chapter is divided into five sections. The first provides a description of the participant group, the second, third, and fourth present the results of data analysis as it relates to each of the three problem statements, and the fifth presents data on additional variables that are not related to any one specific problem statement, but do provide additional insight into all problems being addressed. Results of the data analysis are presented as they relate to each problem statement. Complete descriptive statistics and the complete correlation matrix for all variables are provided in Appendix D.

Participant Group

Of the 414 teachers asked to participate, data was available for 382 (92.3%). Two of these records were omitted since it was not possible to separate frequency of use data for these two respondents (they shared an e-mail ID). Of the remaining 32 teachers (7.7%), one declined to participate when contacted citing the reason of being "too busy". The remainder simply failed to respond to the original request to participate or to the follow-up request to participate. Table 4 summarizes the characteristics of the participating group.

Table 4: Summary of Participant Group Characteristics

	Jur X Number	Jur X Percent	Jur Y Number	Jur Y Percent	Division Total	Division Total %
Asked to Participate	169/414	40.8	245/414	59.2	414	100
Sample Proportion	153/382	40.0	229/382	60.0	382	100
Response Rate	153/169	90.5	229/245	93.5	382/414	92.3
Usable Response Rate	153/169	90.5	227/245	92.7	380/414	91.8
Female Respondents	85/153	55.6	136/227	59.9	221/380	58.2
Male Respondents	68/153	44.4	91/227	40.1	159/380	41.8
Primary Assignment Kindergarten	0/380	0.0	5/380	1.3	5/380	1.3
Primary Assignment grades 1-6	76/380	20.0	110/380	29.0	186/380	48.9
Primary Assignment grades 7-9	35/380	9.2	51/380	13.4	86/380	22.6
Primary Assignment grades 10-12	36/380	9.5	48/380	12.6	84/380	22.1
Primary Assignment Special Education	6/380	1.6	13/380	3.4	19/380	5.0
Mean Age	42.9	n/a	39.0	n/a	40.5	n/a

An average of 128.8 messages were sent and 162.0 messages were received for each of the 114 participating teachers who have school district electronic mail system IDs. In total, over 36,000 messages were handled by the district mail system during the month of March. Almost 40% of the teachers in the district report using the district mail system, even though only 30% actually have a system ID. This is an indication that several mail system IDs are being shared. This translates to 93.0 messages sent and 116.1 messages received per teacher reporting use of the system. Table 5 summarizes participant characteristics with respect to electronic mail and computers at home and work.

Table 5: Summary of Participant Group Characteristics with Respect to E-Mail and Computers at Home and Work

	Jur X Number	Jur X Percent	Jur Y Number	Jur Y Percent	Division Total	Division Total
Know About District E-Mail	89/153	58.2	219/227	96.5	308/380	81.1
Use District E-Mail	0/153	0.0	151/227	66.5	151/380	39.7
Have District E-Mail	0/153	0.0	114/227	50.2	114/380	30.0
Have Other E-Mail ID	10/153	6.5	22/227	9.7	32/380	8.4
Have Home Computer	93/153	60.8	138/226	61.1	231/380	60.9
Have Computer at Workspace	54/153	35.3	204/227	89.9	258/380	67.9
Do not Use Computers*	32/128	25.0	19/168	11.3	51/296	17.2
Use Computers at the Utilization Level*	88/128	68.8	121/168	72.0	209/296	70.6
Use Computers at the Integration Level*	8/128	6.3	28/168	16.7	36/296	12.2
Reported Removal of Computers would have Significant Effect**	34/115	29.6	97/207	46.9	135/322	43.3

*Includes only teachers who provided consistent responses to the LUA

**Includes computer users only

Over half of the teachers in founding Jurisdiction X are aware of the district mail system in spite of the fact that the two jurisdictions merged only three months prior to the collection of data. Twice the proportion of Jurisdiction Y teachers have personal electronic mail IDs on other systems not associated with the school division, but the numbers are small at 8.4% overall. The proportion of home computer ownership is close to equal between the two jurisdictions, but access to a computer at the workspace is dramatically different. Almost 90% of Jurisdiction Y teachers had a computer at their workspace compared to only 35.3% of Jurisdiction X teachers. Problem 3 addresses differences between the two jurisdictions in detail.

Eighty-four respondents provided inconsistent responses on the LUA measure by not following one of the two predicted patterns for computer users. The remaining 296 respondents were either not computer users, or followed one of the two predicted patterns for computer users. Of these, almost 73% use computers, but only slightly over 12% are using computers at the integration level. The ERS was much less restrictive, and all but 7 respondents completed this scale. Of these, 322 were computer users, and 43.3% of these users reported that removal of all computers from the school would have a significant effect on the way they teach.

The results for the LUA measure and the ERS are both very different between the two jurisdictions. These differences will be discussed in greater detail later in this chapter when jurisdictional differences are discussed.

Problem 1: Electronic Mail and Teachers' Level of Use of Computers

Three data analysis procedures are utilized to investigate the relationship between use of electronic mail and the level of computer use by teachers. The first analysis addresses the first sub-problem by calculating correlation coefficients between all electronic mail variables and all level of use variables. The second analysis addresses the second sub-problem by completing two multiple regressions. Each regression uses one of the level of use variables as a dependent variable, and uses electronic mail variables and predictor variables identified in the research as independent variables. The second regression also includes environmental and demographic variables as independent variables. The third analysis procedure involves splitting the participants into sub-groups according to their level of use of computers as determined by the LUA then conducting an analysis of the written comments made by computer users at each level of computer use.

The measurement of the level of use of computers presented some problems. The LUA measure required computer-using respondents to follow one of two predicted patterns. Eighty-four records were omitted from the resultant *LCU* variable due to respondents not following one of the two predicted patterns. One respondent commented that the choices were too restrictive, and several respondents commented that the instrument was redundant. The comments about redundancy resulted from each of four statements being used twice in the instrument.

Rejection of 84 records was unacceptable, so the LUA was rescaled (*LCU 4-12*) to allow the data from these respondents to be included in the analysis. This was done in addition to, not instead of, the original intent of the LUA, and both scales are included in the analysis. The new scale provided a finer interval between the utilization level and the integration level of use, but excludes non-users.

Descriptive Statistics for Electronic Mail and Level of Use Variables

Two electronic mail variables and four level of use variables were utilized to investigate the relationship between Electronic mail use and the level of use of computers by teachers. The two electronic mail variables were *Use of District Mail,* and *Frequency of Use of District Mail.* The four level of use variables included the three derived from the LUA (*LCU, LCU 4-12,* and *Integration*) plus the *Removal* variable. Descriptive statistics for each of these variables are presented in Table 6.

Table 6: Means Scores for Level of Use Variables and for E-Mail Variables

Variable	n	Mean	SD.	Possible Range	Actual Range
Use of District mail System	380	1.397	.490	1-2	1-2
Frequency of Use of District Mail System	380	85.105	193.968	0-n	0-1909
LCU (3 position continuous)	296	.949	.541	1-3	1-3
Integration	245	1.147	.355	1-2	1-2
LCU 4-12	321	5.685	2.750	4-12	4-12
Effect of Removal	322	1.407	.492	1-2	1-2

Sub-Problem 1.1: Correlational Relationship between Electronic Mail and Level of Use

To address the first sub-problem correlation coefficients using pairwise deletion were calculated using all of the above variables. The results are presented in Table 7. Participant counts for each correlation are presented below the shading while r values are presented above the shading. Since *Integration* and *LCU 4-12* are subsets of *LCU* the correlation between these variables is r = 1.00 using pairwise deletion. A complete correlation matrix for all variables is provided in Appendix D.

Table 7: Correlation Coefficients and n-values for Level of Use Variables and E-Mail Variables

Variable	LCU	Integration	LCU 4-12	Removal	Use District Mail	Freq of Use of District Mail
LCU	▨	1.00††	1.00††	.515††	.240††	.202†
Integration	245	▨	1.00††	.515††	.202**	.138*
LCU 4-12	245	245	▨	.533††	.200†	.122*
Removal	241	241	314	▨	.199†	.223††
Use of District Mail	296	245	321	322	▨	.520††
Freq of Use of D. Mail	296	245	321	322	380	▨

* $p < .05$. **$p < .01$. † $p < .001$ †† $p < .0001$

The two electronic mail use variables were found to be positively and significantly correlated with all level of use variables, but the relationship was generally not as strong as the relationship between the level of use variables and the research-based predictor variables (see the following section addressing Problem 2). *Use of District Mail* was found to be more strongly correlated than was *Frequency of Use* over all four level of use variables, suggesting that it may be the fact that the mail system is used rather than how often it is used that may be influential on the level of use of computers by teachers.

Sub-Problem 1.2: Predictive Relationship Between Electronic Mail and Level of Use

Regression analysis was used to address this sub-problem. The purpose of the regression analysis is to determine if there is an indication of predictiveness on the part of electronic mail with respect to the level of computer use. *Affective Attitudes, Cognitive Attitudes, Innovativeness,* and *Self-Competence* were identified in the research as having a positive and significant relationship with the level of computer use by teachers. This relationship was confirmed by the correlation matrix calculation done for Problem 2 (See Table 13). Two forward stepwise multiple regressions were computed including these four variables as independent variables. The original regression used *LCU* as the dependent variable and the two mail variables as additional independent variables (*Use of District Mail* and *Frequency of Use).* The results of this regression are presented in Table 8.

Table 8: Results of Regression with LCU as dependent variable and Self- Competence, Innovativeness, Cognitive Attitude, Use of District Mail, Affective Attitude, and Frequency of Use of District Mail as Independent Variables

Predictor Variable	Standardized Coefficient	F-to-Remove
Self- Competence	.188	9.518
Innovativeness	.179	11.125
Use of District Mail	.149	8.216
Cognitive Attitude	.157	7.801
Affective Attitude	.146	6.239

n = 294, missing = 86, intercept = -1.001, r = .521, F= 21.476, p<.0001

Variables are shown in the order that they were entered into the regression equation by StatView. The results suggest that these variables predict 27% of the level of use of computers as measured by the LUA.

The second regression was calculated using *LCU 4-12* as the dependent variable. This was done for two reasons: first to include the data from the 84 computer users that were omitted by the determination of *LCU,* and second, to provide a true interval variable for the level of use of computers.

The original six variables (*Use of District Mail, Frequency of Use, Affective Attitudes, Cognitive Attitudes, Innovativeness,* and *Self-Competence,)* were retained as independent variables and five additional independent variables were included (*Jurisdiction, Home Computer, Computer at Workspace, Gender,* and *Age*). The second regression took six steps, leaving four variables entered. *Affective Attitudes* was removed at step six. Table 9 summarizes the results of this regression.

Table 9: Results of Regression with LCU 4-12 as Dependent variable and Self- Competence, Innovativeness, Cognitive Attitude, Affective Attitude, Use of District Mail, Frequency of Use of District Mail, Home Computer, Jurisdiction, Computer in Class, Gender, and Age as Independent Variables

Predictor Variable	Standardized Coefficient	F-to-Remove
Cognitive Attitude	.203	14.179
Use District Mail	.179	11.186
Innovativeness	.164	9.521
Gender	.130	6.050

n = 318, missing = 62, intercept = -3.136, r = .370, F=12.398, p<.0001

The regression yielded r =.370 after six steps. *Frequency of Use of District Mail* was displaced by *Use of District Mail*. The results suggest that the remaining four predictor variables predict 14% of the level of use of computers by computer using teachers as measured by the LUA. Variables are listed in order of entry into the regression by StatView.

The two regressions present differing levels of support for the conclusion that use of electronic mail may be predictive of the level of integration of computers by teachers. The first regression includes teachers at all three levels of computer use measured by the LUA, while the second regression includes only those teachers using computers at the utilization level or higher.

Participant Written Comments

To further investigate the relationship between electronic mail use and the level of computer use, the sample was split into sub-groups based on level of use assignment by the *LCU* variable. A total of 244 respondents who are computer users followed one of the two predicted patterns allowed by the LUA. Electronic mail users represent 40.2% of the total number of respondents used in this analysis. Of the sub-group of 208 utilization level users, 36.1% (75) are electronic mail users and 63.9% (133) are electronic mail non-users. The pattern is reversed for integration level users (n=36) with 63.9% (23) being electronic mail users, and 36.1% (13) being electronic mail non-users. The representation of electronic mail users at the integration level is disproportionate to their overall numbers, lending support for the notion that use of electronic mail may contribute positively to the level of computer integration by teachers.

Each of the two groups of computer users (utilization level users and integration level users) was studied separately. In each case the sub-group was further split based on electronic mail use in order to determine what other characteristics besides mail use distinguish the two groups.

A close examination of the comments provided by teachers in each of the two sub-groupings provided further insight into the differences between electronic mail users and electronic mail non-users with respect to the level of integration of computers in instruction. Comments were scanned for common themes and the number and percent of respondents in each group commenting on each theme were calculated and recorded.

Sample sizes became very small for these sub-groups, particularly the integration level users. A small proportion of these participants made written comments which suggests that the percentage values should be viewed with caution.

Utilization Level Users

For utilization level users, 19 electronic mail users provided written comments related to computer use, while 29 electronic mail non-users provided comments related to computer use. Table 10 summarizes the comments of utilization level users.

Table 10: Summary of Written Comment Themes by Utilization Level Users

	E-Mail Users		E-Mail Non- Users	
	n All Jurisdiction Y	%	n (Jur X n/Jur Y n)	%
Lack of equipment, old equipment	1	1.3	12 (10/2)	9.8
Lack of software	3	4.0	3 (2/1)	2.3
Lack of time to develop skills/need for inservice	1	1.3	1 (0/1)	0.8
Use of computers is underdeveloped, but not due to lack of equipment/software	0	0.0	3 (1/2)	2.3
Teacher uses computer for prep work, admin, saves time	11	14.6	11 (9/2)	8.2
Expressed desire for improved use in instruction	6	6.7	7 (6/1)	5.3
Stated that they are presently actively learning	2	2.6	0 (0/0)	0.0
Expressed need for student competence and use	2	2.6	3 (3/0)	2.3
Expressed negative comments towards computer use	0	0.0	3 (3/0)	2.3
Number of respondents making written comments	20	26.7	31 (24/5)	23.3

e-mail users n=75, e-mail non-users n=133

For utilization level users, a high number (12) of non-users of electronic mail who made comments complained about the lack of equipment, or the out-of-date nature of equipment. This comment was made by only one electronic mail user. The quantitative data confirms that there is a significant difference in access levels for users and non-users of electronic mail. The same number of electronic mail users commented on the use of computers for teacher preparation work as did electronic mail non-users, but at almost twice the proportion. The degree of importance placed on this function was apparent by the manner in which it was expressed. Eight of the 11 electronic mail users used strong phrases to emphasize the importance of the computer in this area, while 8 of the 11 electronic mail non-users did likewise. Electronic mail users and non-users both expressed a desire for improved instructional use of computers, with a somewhat higher proportion of electronic mail users expressing this theme. Three non-users of electronic mail made negative comments about the value of using computers in school, with one respondent being quite emphatic. Two electronic mail users commented on how they were actively learning more about using computers at the present time, indicating acceptance of their role as a learner.

Integration Level Users

For integration level users, 6 electronic mail users provided written comments related to computer use, while 4 electronic mail non-users provided comments related to computer use. Table 11 summarizes the comments of integration level users.

Table 11: Summary of Written Comment Themes by Integration Level Users

	E-Mail Users		**E-Mail Non- Users**	
	n All Jurisdiction Y	**%**	**n (Jur X n/Jur Y n)**	**%**
Lack of equipment, old equipment	0	0.0	2 (1/1)	15.4
Use school computers little, home computers a lot	0	0.0	2 (1/1)	15.4
Teacher uses computer for prep work, admin, saves time	1	4.3	2 (1/1)	15.4
Commented on use of Internet in instruction	2	8.7	0 (0/0)	0.0
Expressed desire for improved use in instruction	3	13.0	1 (0/1)	7.7
Expressed need for student competence and use	4	17.4	0 (0/0)	0.0
Number of respondents making written comments	5	21.7	4 (2/2)	30.8

e-mail users n=23, e-mail non-users n=13

The number of participants in the integration level group is quite small (36), but the proportion of users in this group making comments was generally higher than for the utilization level group. Access to equipment was again an issue with electronic mail non-users. The quantitative data supports this concern. Only 61.5% of electronic mail non-users have a computer in their classroom, while 100% of electronic mail users do.

The overall pattern of comments made by teachers at the integration level is dichotomous between electronic mail users and electronic mail non-users (Table 11). Half of the electronic mail non-user respondents that provided comments complained about access to equipment or the vintage of the equipment available. Half indicated that they use computers for preparation work, and these same two respondents indicated in very direct terms that this work and instructional work was done at home rather than on a computer at school: "I would use my home computer only"; "almost 100% of my computer usage related to my teaching duties and instruction is done at home". Only one electronic mail non-users expressed a desire to improve the use of computers in instruction: "I would like to try as much as possible to enhance learning in my classroom". No electronic mail non-users expressed a need for student use, with one actually stating that "student use would be nil". None of the non-users mentioned use of the Internet for instruction, but one did mention personal use at home.

By contrast, none of the integration level electronic mail users complained about access to or quality of equipment. No mention was made of home computer use for preparation by electronic mail users, with comments addressing in-school use by students instead. The one participant that did mention preparation work, but did so as part of a triad of computer use: "computers are essential to teaching/planning/learning". All five of the integration level electronic mail users indicated the critical nature of computer use at school with the terms *must, essential, cannot function without, NEED,* and *essential.* Four of the five provided comments regarding the need for students to use computers, and two mentioned the use of the Internet in their instruction.

Overall the comments suggest that electronic mail users may be more focused on student use of computers at school while their non-using peers are more focused on teacher use for preparation.

Problem 1 Summary

The data analysis indicates the presence of a relationship between electronic mail use and the level of computer use by teachers. Correlations between all electronic mail variables and all level of use variables are positive and significant. The regression did not indicate a strong predictive role for electronic mail use and the predictor variables identified in the research, but there was some indication that a predictive relationship may exist. The written comments are quite different between electronic mail users and electronic mail non-users at the integration level. Electronic mail users focused on instructional issues while there non-using peers focused on preparation issues. These results are discussed in detail in Chapter Five.

Problem 2: Electronic Mail and Predictor Variables Identified in the Research

Correlation calculations and t-tests are employed to investigate the relationship between electronic mail use and the four predictor variables identified in the research (*Affective Attitudes, Cognitive Attitudes, Innovativeness,* and *Self-Competence).* Correlations coefficients using the entire sample were calculated between electronic mail variables and the four research-based variables. Computer users were then sub-grouped based on level of use assignment by the LUA and means of the four variables were compared between electronic mail users and non-users in each of the two groups using t-tests.

The follow-up data collection from teachers with district e-mail IDs was also utilized to investigate the relationship between use of electronic mail and *Self-Competence*.

Descriptive Statistics for Electronic Mail and Predictor Variables

Descriptive statistics for the two electronic mail variables are presented in Table 6 above. Descriptive statistics for the four variables identified in the research are presented in Table 12.

Table 12: Means Scores for Predictor Variables Identified in the Research

Variable	n	Mean	SD.	Possible Range	Actual Range
Affective Attitudes	380	48.855	10.834	10-70	10-70
Cognitive Attitudes	380	18.168	3.167	3-21	3-21
Innovativeness	380	49.634	8.436	10-70	25-70
Self-Competence	378	5.516	1.521	1-7	1-7

The mean of the *Affective Attitudes* score of 48.9 is .82 of a standard deviation above the median value of 40, which suggests that overall district teachers have positive feelings about their experiences using computers. The range of responses covers the entire possible range, indicating that some teachers are fully comfortable with using computers, while others appear to have very negative feelings towards personally using a computer. The *Cognitive Attitudes* scale mean of 18.2 is 1.95 standard deviations above the median value of 12, and is approaching the maximum value of 21, indicating that these teachers believe strongly in the relevance of using computers. Adjusting the standard deviation for *Cognitive Attitudes* to compensate for scale differences indicates a similar variance in responses for both attitude scales.

The *Innovativeness* mean of 49.6 is 1.1 standard deviations above median value of 40, indicating that overall, these teachers tend to be innovative.

The mean value for *Self-Competence* indicates that teachers in the district generally feel competent in their ability to use a computer, with the mean of 5.5 lying one standard deviation above the median value of 4.

Of the four variables, *Self-Competence* has the largest standard deviation (corrected for scale differences) indicating the respondents are less similar with respect to this variable than with respect to the other three. *Innovativeness* had the smallest standard deviation, indicating that it is on this scale that respondents are most similar.

Correlation Coefficients for Electronic Mail and Predictor Variables Identified in the Research

LCU, *Integration*, *LCU 4-12*, and *Removal* variables are included in the following correlational matrix for clarity. The two electronic mail variables and the four research-based predictor variables make up the remainder of the correlation matrix contained in Table 13 below. Participant counts for each correlation are presented below the shading while r-values are presented above the shading. A complete correlation matrix for all variables is provided in Appendix D.

Table 13: Correlation Coefficients and n-values for Level of Use Variables, E-Mail Variables, and Research-Based Predictor Variables

Variable	LCU	Integ	LCU 4-12	Rem	Use DM	Freq Use DM	Aff Att	Cog Att	Inn	Self C
LCU	■	1.00††	1.00††	.515††	.240††	.202†	.360††	.336††	.304††	.399††
Integration	245	■	1.00††	.515††	.202**	.138*	.193**	.262††	.230†	.230†
LCU 4-12	245	245	■	.533††	.200†	.122*	.226††	.262††	.189†	.222††
Removal	241	241	314	■	.199†	.223††	.262††	.243††	.206†	.243††
Use of District Mail	296	245	321	322	■	.520††	.199††	.190†	.026	.192†
Freq of Use of D. Mail	296	245	321	322	380	■	.168†	.133**	.116*	.119*
Affective Attitude	296	245	321	322	380	380	■	.300††	.315††	.443††
Cognitive Attitude	296	245	321	322	380	380	380	■	.204††	.423††
Innovativeness	296	245	321	322	380	380	380	380	■	.283††
Self-Competence	294	243	319	320	378	378	378	378	378	■

* p< .05. **p < .01. † p < .001 †† p < .0001

Level of Use and Research-based Predictor Variables

All predictor variables relating to factors identified in the research (*Affective Attitude, Cognitive Attitude, Self-Competence, Innovativeness*) were found to be significantly and positively correlated with the four level of use variables, thus confirming the relationship reported in the literature. When the LUA data is treated as continuous over all three categories (*LCU*) the correlations tend to be more positive than when the LUA data is rendered for computer users only (*Integration* and *LCU 4-12*). *Cognitive Attitudes* resulted in p values of $p < .0001$ over all four level of use variables. *Affective Attitudes* was not found to be as positively correlated with *Integration* ($p < .01$) as it was with *LCU*, *LCU 4-12*, and *Effect of Removal* ($p<.0001$). *Innovativeness* was found to be more positively correlated with *LCU* ($p<.0001$) than with *Effect of Removal*, *Integration* and *LCU 4-12* ($p<.001$). *Self-Competence* was found to be more positively correlated with *LCU*, *Effect of Removal*, and *LCU 4-12* ($p<.0001$) than with *Integration* ($p < .001$).

All predictor variables based on factors identified in the research were found to positively correlated with each other and yielded $p<.0001$ in all cases. The correlation coefficients range from $r=.204$ for *Innovativeness:Cognitive Attitudes* to $r=.443$ for *Affective Attitudes:Self-competence*.

Electronic Mail and Predictor Variable Correlations

Use of District Mail and *Frequency of Use* were both significantly and positively correlated with *Affective Attitudes*, producing p-values of $p<.0001$ and $P<.001$ respectively. The same is true for *Use of District Mail* and *Frequency of Use* with respect to *Cognitive Attitudes*, but the p values were weaker at $p<.001$ and $p<.01$ respectively.

The relationship between *Innovativeness* and the two mail variables (*Use of District Mail* and *Frequency of Use)* was weaker, with only *Frequency of Use* being significantly and positively correlated with *Innovativeness* ($p<.05$).

Self-Competence was significantly and positively correlated with both mail variables, having accompanying p-values of $p<.001$ for *Use of District Mail* and $p<.05$ for *Frequency of Use*.

Examination of Sub-groupings of Computer Users Based on LCU Assignment

The same sample splitting technique employed in investigating the first problem was utilized for this problem. Participants were sub-grouped based on the level of use assignment by the *LCU* variable. Each of the two groups of computer users (utilization level users and integration level users) was studied separately. In each case the sub-group was further split based on electronic mail use. The means of electronic mail users were then compared to the means of electronic mail non-users using single tailed t-tests for each of the four predictor variables.

Utilization Level Users

The results of the t-tests for utilization level users are presented in Table 15.

Table 15: T-Test Results Between Utilization Level Electronic Mail Users and Non-Users on Selected Variables

	User $\bar{X}$	Non-User $\bar{X}$	$\bar{X}_u - \bar{X}_n$	t-value	p-value
number of participants **source of n (Jur X n/Jur Y n)**	n=75 (0/75)	n=134 (88/46)			
Affective Attitudes	50.653	47.343	3.310	2.432	.0079**
Cognitive Attitudes	18.600	17.642	.958	2.112	.0179*
Innovativeness	48.467	49.948	1.481	1.217	.8875
Self-Competence	5.813	5.424	.389	1.918	.0283*
Computer at Work	1.960	1.493	.467	7.733	<.0001††
Home Computer	1.608	1.627	.019	.266	.6046

$^{*}p<.05$, $^{**}p<.01$, $^{\dagger\dagger}p<.0001$

The results for utilization level users indicate that on three of the four measures of factors identified in the research, electronic mail users exhibit significantly higher levels. Electronic mail users have more positive affective and cognitive attitudes towards computer use and feel more competent using computers when compared to their peers who do not use electronic mail. Electronic mail users are also more likely to have a computer in their classroom or office, but this is to be expected since an electronic mail ID is not generally assigned unless the teacher has direct access to a computer.

Integration Level Users

The results of the t-tests for integration level users are presented in Table 16.

Table 16: T-Test Results Between Integration Level Electronic Mail Users and Non-Users on Selected Predictor Variables

[illegible]	**User $\bar{X}$**	**Non-User $\bar{X}$**	**$\bar{X}_u - \bar{X}_n$**	**t-value**	**p-value**
number of participants **source of n (Jur X n/Jur Y n)**	n=23 (0/23)	n=13 (8/5)			
Affective Attitudes	52.870	55.692	-2.823	.770	.7766
Cognitive Attitudes	20.304	20.154	.151	.397	.3469
Innovativeness	53.957	56.231	-2.274	1.214	.8834
Self-Competence	6.304	6.692	-.388	1.765	.9568*
Computer at Work	2.000	1.615	.385	3.685	.0004†
Home Computer	1.565	2.000	-.435	3.073	.9979**

*p<.05, ** p < .01

The results for integration level users tell a different story. Of the predictor variables identified in the literature, only *Self-Competence* resulted in a significant difference in means between electronic mail users and electronic mail non-users. In this case, the relationship is reversed from that for utilization level users in that the electronic mail non-users exhibit a higher level of *Self-Competence*. For both groups though, the level was high at 6.3 and 6.7. The correlation matrix revealed a significant positive correlation between *Home Computer* and *Self-Competence* (see Appendix D). Only 56.5% of electronic mail users at this level of computer use (integration) have home computers, while 100% of electronic mail non-users have home computers. This may explain the higher level of *Self-Competence* expressed by electronic mail non-users.

Follow-up Data Analysis: Electronic Mail Use and Self-Competence

The effects of electronic mail use were not clear after analyzing the initial data. While the correlations in the previous section are considered significant, they are not as strong as expected. This contributed to the decision to obtain follow-up data from those teachers who have a district mail ID. Four yes/no response questions were asked (see Appendix B). It was not possible to merge this data with the initial records since the ability to identify respondents had previously been destroyed. Frequency Distributions for the four items is presented in Table 14.

Table 14: Frequency Distribution for all No/Yes Follow-up Data Items.

	Total Group								**By Prev Use**			
	Used Before		**Use More**		**More Self-C**		**All Should**		**Novice Self-C**		**Vet Self-C**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
No	11	11.0	12	12.0	22	22.0	1	1.0	1	9.0	21	23.6
Yes	89	89.0	88	88.0	78	78.0	99	99.0	10	90.9	68	76.4
Total	100	100	100	100	100	100	100	100	11	100	89	100

Did you use a computer before you got a district ID?
Do you use a computer more now that you have a district ID?
Do you feel district mail was helpful in increasing you level of competence in using a computer?
Do you think all teachers should have a district mail ID?

The follow-up data indicated that the relationship between use of the district mail system and self-competence using a computer is actually very strong. Seventy-eight percent of teachers with IDs indicated that use of the mail system improved their competence in using a computer. Of the 11 teachers who were new to computers when they got their ID, only one felt it did not help increase competence. This respondent also indicated that a computer was not used before getting an ID, and that computer use did not increase after getting the ID. One interpretation is that this teacher still does not use a computer. Another is that this teacher does use a computer now, but that the district mail system has had no effect in determining that use. This teacher did feel however, that all teacher should have an ID on the system.

Comments were not solicited with the secondary data collection, but the following comments of one teacher may serve to illustrate the relationship: "Just to let you know, once I had QuickMail at my disposal my level of competence has improved immensely. Thanks!!!!!".

Problem 2 Summary

The correlation matrix indicates that a positive correlation exists between electronic mail uses and the factors identified in the research as being predictive of the level of computer use by teachers. Data from electronic mail users at the utilization level tends to confirm this relationship, with electronic mail users scoring significantly higher on all scales except *Innovativeness*. At the integration level, these differences disappeared however, and even reversed with respect to self-competence. This reversal may be more due to the presence of a home computer than use of electronic mail. Both groups exhibited very high levels of self-competence. The most striking evidence of a positive effect from using electronic mail on the perception of self-competence comes from the follow-up data collection. This data clearly indicates a strong positive relationship between use of the district electronic mail system and the perception of self-competence held by teachers with system IDs.

Problem 3: Jurisdictional Differences

The recent amalgamation of two school districts with different approaches to technology deployment and support presented an opportunity to investigate the differences between the two teaching populations with respect to the variables used in this study. Population descriptive statistics are provided, followed by results of t-test comparing the means of the two teacher populations on all level of use variables and all research-based predictor variables. Electronic mail variables are not included since only one jurisdiction had access to electronic mail at the time of the study.

Descriptive Statistics

The sample was split by founding jurisdiction and descriptive statistics for selected variables were generated. Frequency distributions for these variables are provided by sub-group based on founding jurisdiction in Tables 17 through 20.

Table 17: Frequency Distribution for selected No/Yes Variables by Jurisdiction

	Have Other ID				Have Home Comp				Have Comp in Class			
	Jur X		Jur Y		Jur X		Jur Y		Jur X		Jur Y	
	n	%	n	%	n	%	n	%	n	%	n	%
No	143	93.5	205	90.3	60	39.2	88	38.9	99	64.7	23	10.1
Yes	10	6.5	22	9.7	93	60.8	138	61.1	54	35.3	204	89.9
Total	153	100	227	100	153	100	226	100	153	100	227	100

Table 18: Frequency Distribution for LCU

	LCU			
	Jur X		Jur Y	
	n	%	n	%
Non Use	32	25.0	19	11.3
Utilization	88	68.8	121	72.0
Integration	8	6.3	28	16.7
Total	128	100	168	100

Table 19: Frequency Distribution for Effect of Removal Scale

	Effect of Removal			
	Jur X		Jur Y	
	n	%	n	%
No Effect	36	24.5	29	12.8
Little Effect	74	50.3	99	43.8
Significant Effect	37	25.2	98	43.4
Total	147	100	226	100

Table 20: Frequency Distribution Access to a Computer at School

	Acc to Comp			
	Jur X		Jur Y	
	n	%	n	%
no access	2	1.4	0	0
no easy access	17	11.6	6	2.6
easy access	73	50.0	15	6.7
computer in classroom or office	54	37.0	204	90.7
Total	146	100	225	100

One striking environmental factor is the degree of access to a computer. Over 90% of Jurisdiction Y teachers report a computer in their workspace or office at school compared to only 37% of Jurisdiction X teachers. Only 2.6% of Jurisdiction Y teachers report difficulty in accessing a computer at school, while 13.0% of Jurisdiction X teachers report either no access or difficulty in accessing a computer at school. These differences are tempered by the report of 50% of Jurisdiction X teachers indicating that although they do not have a computer in their classroom or office, they do have easy access to a computer in the school. These results are not surprising given the two very different histories of the jurisdictions regarding support for technology.

Also very apparent is the fact that Jurisdiction Y had over three times as many, and proportionally well over twice as many teachers using computers at the integration level. In relative terms these differences are quite distinct, but in absolute terms, Jurisdiction Y still had only about 17% of teachers using computers at the integration level. The ERS indicated a more significant role for the computer in instruction, with 25% of Jurisdiction X and 43% of Jurisdiction Y teachers reporting that removal of all computers would have a significant effect on their teaching.

While slightly more Jurisdiction Y teachers than Jurisdiction X teachers use other forms of electronic mail (not associated with the district), both proportions are quite low at 9.7% and 6.5% respectively.

Results of t-tests for Level of Use and Predictor Variables

Table 21 presents the results of single tailed t-tests conducted on differences in means between teachers in each jurisdiction on all level of use and predictor variables with the exception of mail (mail is only available in Jurisdiction Y).

Table 21: T-Test Results Between Jurisdictions on all Level of Use and Predictor Variables except Mail Variables

	Jur X $\bar{x}$	Jur Y $\bar{x}$	$\bar{x}_y - \bar{x}_x$	t-value	p-value
LCU	.812	1.054	.241	3.890	$<.0001^{\dagger\dagger}$
Integration	1.062	1.167	.104	2.742	$.0032^{**}$
LCU 4-12	5.169	5.985	.816	2.585	$.0051^{**}$
Effect of Removal	1.252	1.434	.182	3.626	$.0002^{\dagger}$
Affective Attitudes	46.222	50.630	4.408	3.964	$<.0001^{\dagger\dagger}$
Cognitive Attitudes	17.549	18.586	1.037	3.167	$.0008^{\dagger}$
Innovativeness	48.915	50.119	1.204	1.366	.0864
Self-Competence	5.265	5.683	.418	2.637	$.0087^{**}$

$^{**}p < .01$, $^{\dagger}p < .001$, $^{\dagger\dagger}p < .0001$

Clear distinctions between the two jurisdictions are apparent with significant differences between jurisdiction mean scores on all level of use variables and all predictor variables with the exception of *Innovativeness*. The results suggest that Jurisdiction Y teachers use computers at a significantly higher level of integration, have more positive affective and cognitive attitudes about the use of computers, and feel more competent in their ability to utilize computers.

Problem 3 Summary

The differences between the mean scores of teachers from the two founding jurisdictions was expected based on the historical difference in support for technology. The data supports a conclusion that the manner in which technology has been implemented in Jurisdiction Y (including the provision of electronic mail for teachers) has had a positive effect on the level of use of computers by teachers and the associated factors identified in the research.

Summary of Additional Variables

Of the five other variables included in the correlation, *Jurisdiction* and *Computer at Workspace* produced positive correlations of note. *Jurisdiction* correlated positively and significantly with all level of use and predictor variables except *Innovativeness. Use of District Mail* and *Frequency of Use of District Mail* also positively and significantly correlated with *Jurisdiction*, but this correlation is meaningless since the district mail system is only available in Jurisdiction Y.

Having a computer at the workspace has the following significant and positive correlations: *Removal*, *Affective Attitudes* ($p<.0001$); *Integration* ($p<.01$); *Cognitive Attitudes, Innovativeness,* and *Self-competence* ($p<.05$). There is also high positive correlation with the mail variables, but this is expected because generally a teacher does not get a mail ID unless they have a computer at their workspace. A high positive correlation was also evident between having a computer at the workspace and *Jurisdiction.*

Having a home computer did not significantly correlate with any variables other than positive correlations with *Innovativeness* ($p<.05$) and *Self-competence* ($p<.01$). Similarly, *Gender* provided few correlations, indicating only that slightly more males tended to use computers at the integration level, would feel slightly more effect if all computers were removed from schools, have slightly more positive feelings about using a computer, and are slightly more likely to have a computer at home. There was no significant correlation between *Gender* and *LCU* or *Integration.*

Age is negatively and significantly correlated with several other variables. These include *Cognitive Attitudes* ($p<.05$), *LCU, Innovativeness, Self-competence,* ($p<.01$), *Affective Attitudes* ($p<.001$), and *Use of District Mail* ($p<.0001$). This would tend to support a conclusion that younger teachers are more likely to utilize technology.

Conclusions

Overall the primary data does indicate a relationship between use of electronic mail and the level at which teachers use computers as well as the predictors of use identified in the literature. The follow-up data implies a much stronger relationship than was uncovered in the primary data. The regression analysis indicates that a predictive relationship may exist between use of electronic mail and the level of computer use, but this evidence is not strong. The differences in the jurisdiction results were anticipated due to the difference in support for technology between the two districts. Chapter Five will discuss the interpretation of these findings.

Chapter V

Discussion of Results

Introduction

In this chapter we revisit the context and the purpose of this study. The chosen methodology is then discussed in light of the findings. The results presented in chapter four are next discussed including the theoretical and practical relevance of this study. Finally, recommendations for further research and for practical application are provided.

The Purpose of the Study

In introducing this study, the concept that our education system may be out of step with the needs of our students was presented. Humanity is accumulating more and more knowledge at an ever increasing rate, yet public education remains essentially content-oriented. As our body of knowledge becomes increasingly dynamic, the accumulation during schooling of a sufficient amount of useful knowledge to last a lifetime becomes less viable. Providing learning skills and developing the aptitude and desire for lifelong learning however, is a viable strategy for preparing young people for adult life.

The strongest critics of public education advocate an abolishment of schooling as we know it, comparing it to the horse and buggy trade in the era of the automobile (Perelman, 1992). Within the education community however, the prognosis is much more favorable. This study is premised on the argument presented by Sheingold (1991), that three distinct, yet intertwined, change agendas must progress concurrently to achieve the synergy necessary to align public schooling with the learning needs of students. Sheingold speaks of a need to empower schools and teachers with a movement to site-based decision making, thereby freeing schools from the bureaucracy that prevents them from adjusting programs to meet the dynamic needs of students. She also speaks of an emerging consensus on teaching and learning that involves less knowledge transfer through didactic instruction and more knowledge discovery through cooperative learning and active participation in learning by students. The third requisite for realigning schooling is the well-integrated use of technology. Sheingold contends that the potential for positive change resulting from each of restructuring, active learning, and well-integrated use of technology is very large, but that none of these movements is likely to achieve any significant gains for students without concurrent progress on the other two.

Within Sheingold's framework, this study specifically addresses integrated use of technology utilizing an existing measure of integration and several measures of identified predictors of integration. The primary purpose of the study is to explore the concept of electronic mail acting as a “first-step” activity for teachers that will break through the personal barriers to technology adoption and facilitate further discovery.

In designing the methodology for this study, the goal of integration of technology was identified early as the focus. Factors that are identified in the literature as being influential on the level of integration of technology were included, both to reaffirm their relationship with integration of computers, and to explore their relationship with use of electronic mail. Use of electronic mail is the aspect of this study that represents original research, and the goal was to determine the relationship, if any, between use of an attractive, easy to use, and locally well connected electronic mail system and the above factors.

Methodology

Measuring Level of Computer Use

Two major shortcomings in the use of the Levels of Use Assessment (LUA) for this study became apparent. The first, inconsistent responses, was anticipated, but not to the degree that it occurred. While some respondents were expected to follow an inconsistent pattern, the number was unacceptably high. This problem was addressed when the LUA was rescaled (*LCU 4-12*) to allow the data from the 84 omitted respondents to be included in the analysis.

The second problem had to do with the interval between levels measured by the LUA. Although not entirely intended to be an interval measure, the LUA has been used as such by its author (Marcinkiewicz, 1994) for exploratory work. The problem with doing so in this study had to do with the coarse increments of the scale. The new scale provided a finer interval between the utilization level and the integration level of use, but the influence being investigated is thought to have its greatest affect on teachers whose level of use is between the non-use and utilization levels. Unfortunately it was not possible to devise a justifiable strategy for developing a finer interval between non-use and utilization.

The LUA is based on the Rieber and Welliver (1989) five level model of instructional transformation, but it measures only the first three levels. Levels two and three of the LUA correspond directly with the utilization and integration levels of the model of instructional transformation, but the correspondence at level one is less than perfect. The LUA specifies non-use of computers for teaching as the critical attribute of level one, while the Rieber and Welliver model specified early familiarization. The distinction may be subtle, but it is these early stages of familiarization that the effect of electronic mail use as an inservice tool may be most pronounced. The LUA provides no increments between non-use and utilization.

Since only the first three levels are represented, the LUA forces all results to cluster at the lower end of the Rieber and Welliver model. With 73% of LUA respondents using computers, but only 12% at the highest LUA level of 'integration', it may be too early in the process of technology integration to gain an effect measure of teacher's level of use with a forced pair type of instrument.

The notion of electronic mail being a “first step” activity for teachers is based on the effect electronic mail would have in helping teachers who are relatively new to computer use. Since the LUA does not provide an effective measure of the level of computer use by teachers at these early stages of computer use, it may have been an inadequate measure for accurately gauging the effect of electronic mail use. A finer scale across all three levels measured by the LUA may have yielded a more useful gauge of the level of use of computers. The rescaling done to arrive at the *LCU 4-12* variable did provide a usable variable for regression analysis, but it shortened the range of measurement to only include computer users at or beyond the utilization level.

The Effect of Removal Scale (ERS) provided a backup measure of levels of use that was less restrictive. Marcinkiewicz (1994) developed the ERS and used it in the same fashion as it was used in this study. Both instruments measure the critical attribute of expendability. The correlation between the raw data from the LUA and the ERS was r = .529, suggesting that the two instruments do not measure the same variable.

One possible explanation for this discrepancy is that the LUA reports personal behavior, while the ERS reports expendability of computers in the school. It is possible that teachers who do not make extensive use of computers personally may still have the way they teach significantly affected by removal of all computers. Perhaps the concern is that the work done for them by support staff would no longer be done, thereby affecting the way they teach.

Since such a high percentage of teachers use computers though, it is more plausible that the difference in measurement is due to the fact that several teachers operating at the utilization level, where the computer is not ‘critical’ or ‘essential’ to teaching, still consider that removal would have a ‘significant’ effect.

Even for teachers using computers at the integration level, where the computer is essential to the way they teach, it is possible, perhaps even likely, that these teachers would misinterpret the intention of the LUA and respond that use of the computer is non-essential. This response would stem from the knowledge that teaching was possible before the advent of computers, so the computer is therefore not essential. Such an interpretation would still result in a 'significant effect' being chosen for the ERS. One utilization level respondent commented "the computer is a major factor in the instruction developed. Obviously I would be *able* to teach without it, so I cannot say it is indispensable". Inclusion of a phrase like 'essential to the way I teach now' or 'essential to the way I currently teach' in the LUA would prevent this misinterpretation.

Measuring Electronic Mail Use

In determining a measure to test the effect of electronic mail use two issues arose. The first was whether or not to simply ask respondents if they felt it made a difference, versus determining a scale of use that could be offered for statistical treatment. The design choice was to opt for statistical treatment of the variable in order to explore its relationship statistically with the level of use of computers and the predictors of such use identified in the literature. The second issue involved choosing a scale to determine the relationship between electronic mail and the other primary variables. Frequency of use would be an effective measure if the perceived effect of using electronic mail was linear in nature, i.e. the more you use it, the more integral computers become with your teaching and the more self competent, innovative, and the more positively disposed towards computers you become. On the other hand, a simple gauge of whether it is used or not may be more enlightening if the effect was less lingering. That is to say that the effect may be substantial at first, but may have little long term effect once the initial benefit has been realized. If the latter is the case, frequency of use would not share a linear relationship with integration of computers.

The premise of the study was that, like a Trojan Horse, the usefulness with respect to clearing the barrier was short-term. The usefulness of mail as a communications tool is not in question, and was excluded from consideration in the delimitations of this study. It is the effect on teacher's decision to pursue or avoid computer use that is at issue. To resolve the choice of variables, both were included.

A problem arose during analysis of the original data collected. The statistical treatment assumes a linear relationship between electronic mail use and the level of computer use by teachers. The relationship was not as apparent in the original data as expected, consequently the follow up data collection was conducted to further investigate the relationship between use of the district electronic mail system and teachers' perceptions of self-competence. Those teachers with district mail accounts were simply asked if they felt it made a difference to their level of competence. The results confirmed that electronic mail was a very significant factor for these teachers.

Interpreting Results

Predictor Variables from the Literature

The results confirm the positive correlational relationship between use of computers and the four predictor variables identified in the research (*Affective Attitudes, Cognitive Attitudes, Innovativeness,* and *Self-Competence*). All four predictor variables are also highly correlated with each other.

The correlation between the attitude scales was moderately positive at $r = .300$; $p<.0001$. A much higher r-value would be expected if affective attitudes and cognitive attitudes were not discrete attributes. The correlation suggests that being comfortable with using a computer may increase the likelihood of perceiving computer use as relevant to learning. Both scales covered the range of responses with similar standard deviations (corrected for scale difference), suggesting that some teachers are extremely comfortable with personally using computers while others find the activity quite unpleasant. Some are firmly convinced of the relevance of computers to teaching and learning, while others see computers as irrelevant. Overall the results indicate that teachers in the district share the belief that computers are an important aspect of schooling (to a greater degree than they personally feel comfortable with using a computer).

Electronic Mail

Electronic mail did positively correlate with the level of use variables, although generally to a lesser degree than the research-based predictor variables. The regression also identified use of electronic mail as a possible predictor of integration as measured by both *LCU* and *LCU 4-12*. The more revealing aspect of electronic mail's influence with respect to perceptions of self-competence comes from the follow-up data.

Of the four predictor variables from the research, Self-*Competence* was the most highly correlated variable with *LCU* (r=.399; p<.0001). The relative rank of *Self-Competence* decreased when correlations were calculated with level of use variables that included only computer users (*Integration, LCU 4-12,* and *Removal).* From the follow-up data, the very large proportion of teachers using electronic mail that indicated a positive effect on their competence using computers confirmed a significant relationship between *Use of Mail* and *Self-Competence*. The overall pattern of results supports the notion that the effect of electronic mail use is strong at first, but its effect is not perpetual. The following points are offered in defense of this interpretation:

1. The follow-up data shows very strong support for the conclusion that e-mail use increases self-competence. This support is much stronger than that evidenced by the initial data set. This is consistent with an interpretation that the effect of mail is pronounced during the initial stages of computer use, when self-competence is being established, but that as computer use matures along the model of instructional transformation, the effect is less important. It is important to consider the temporal elements of the two data sets. The primary data set records current perceptions of self-competence, current use of e-mail, and the current level of computer use. The secondary data instrument asks if use of e-mail helped develop competence, consequently it records historical perspectives. If electronic mail's effect on competence is pronounced at the early stage of adoption of computers, we would expect a historical perspective to indicate a strong relationship between e-mail and self-perception of

competence. If the effect does not continue in a linear fashion, then variance in the amount of use of e-mail would not correlate as strongly with variance in self-perception of competence or level of use of computers. The two data sets exhibit the described patterns.

2. For users of the mail system whose use of a computer was coincident, the support for the notion that use of electronic mail increased their level of competence was near unanimous (Table 18).

3. For users of the mail system whose use of a computer predated their access to mail, the support for the notion that use of electronic mail increased their level of competence was still very strong at 76.4% (Table 18).

4. The positive correlation of both e-mail variables was stronger with the *Effect of Removal* variable than with the three LUA derived variables. This higher positive correlation with *Effect of Removal* may reflect the degree of usefulness of electronic mail for experienced users rather than the influence of electronic mail on the level of integration or self-competence for less experienced users. Experienced users might feel they would suffer a significant effect if electronic mail were removed.

5. The fact that frequency of use is less correlated with *Self-Competence* than is use may suggest that the effect is not lingering. Use of the mail system seems to be more important than the amount of use of the electronic mail system.

The above interpretation does provide one possible explanation as to why the indication of a strong and positive effect from mail is inconsistent between the two data collections. While this above interpretation may be accurate, at this point it remains somewhat speculative.

Access to a Computer Differences

One might interpret the results of the correlation matrix as suggesting that it is access to a computer that produces the observed effect rather than use of electronic mail. All mail users have a computer at the workspace, so the two variables are highly dependent. Three observations indicate that it is mail that is the dominant influence: first, having a home computer provided only a weak pattern of correlation with the primary variables of this study and second, 76% of users who had computers prior to getting their mail accounts reported that mail increased their level of competence. The regression analysis provides a third item of support for the conclusion that use of mail is more influential than access to a computer at the workspace since access to a computer did not achieve entry into the regression. Access to a computer is likely important, but it is also ikely much more effective if it is equipped with a connection to a network with electronic mail.

Electronic Mail Users and Non-User Differences

The examination of the sub-groupings by level of computer use as assigned by the *LCU* variable indicated some differential qualities between electronic mail users and electronic mail non-users. Most striking was the fact that electronic mail users were a disproportionately high segment of integration-level users at 63.9%. Since only 40.2% of computer users in the district are electronic mail users.

At the integration level, the differences in means between electronic mail users and non-users for three of the four research-based predictor variables (*Affective Attitudes, Cognitive Attitudes,* and *Self-Competence*) were significant. *Innovativeness* means for the two groups were not significantly different. This indicates that even for users at the same level of use, electronic mail users are more comfortable with computer use, are more inclined to perceive computer use as relevant to teaching, relevant to learning, and relevant to student adult lives, and are more confident in their ability to use a computer competently.

The written comments suggest that at least two of these teachers recognize their role as learners. Comments regarding the role of the teacher as a learner are absent from the electronic mail non-user group. Participants from both groups commented on use of the computer for preparation work, but only in the electronic mail user group were comments written about the usefulness of the computer to communicate. A higher proportion of electronic mail users than non-users emphasized the importance of the role of the computer in their preparation, and a higher proportion of electronic mail users indicated a desire to increase the level of computer use in the teaching and learning process. Taken together these comments and the quantitative data suggest that the electronic mail users at the utilization level have a lead over their electronic mail non-using peers with respect to the integration of technology.

An unexpected, yet interesting result occurred when comparing the means of integration-level electronic mail users with those of integration-level electronic mail non-users on the research-based predictor variables. Only one of these variable showed a significant difference (*Self-Competence*, $p<.05$), and this difference favored the non-user. All electronic mail non-users at the integration level have home computers, but only 56.5% of electronic mail users at this level have home computers. Having a home computer positively correlated with *Self-Competence*. The difference in the proportion of these teachers in each group that have home computers likely accounts for this unexpected result. The results also suggest that without access to the district electronic mail system, it is unlikely that the integration level of use can be achieved unless a home computer is present.

The dichotomous nature of the pattern of comments made by users at the integration level indicates that electronic mail users and non-users have differing views as to what constitutes "essential" or "critical" roles for computers in their teaching. Non-users of electronic mail emphasized home-based computer use, and commented negatively on use of computers by students ("student use would be nil"). Electronic mail users made no mention of home based-use, instead focusing on school-based instructional issues and student use. This pattern of views parallels relative positions on a hypothetical scale measuring from dichotomous teaching at one end of the scale to learner-centred teaching at the other end. There is no data available to locate respondents on such a scale, but the data does support relative positioning. Electronic mail non-user comments emphasize teacher preparation activities outside the classroom, while electronic mail user comments support classroom-based activities with students as active participants. These comments suggest that electronic mail users are closer to the learner-centred end of this hypothetical scale than are their electronic mail non-using counterparts.

Even though these teachers were all assigned to the integration level by their responses to the LUA, their comments indicate that the role they see the computer playing is different. Lack of access to electronic mail and a computer in the classroom for electronic mail non-users (61.5% have computers at their workspace vs. 100% of electronic mail users) may have forced the out-of-class focus. Providing these teachers with computers in the classroom that are connected to electronic mail might eliminate the dichotomy of views.

Jurisdictional Differences

The recent merging of two founding jurisdictions to form a regional district provided an opportunity to explore differences between the two sub-groups with respect to the variables used in this study. Differences were expected, given the historical difference in approaches to technology deployment and support between the two jurisdictions.

The t-tests in Table 21 confirm that the two sub-groups exhibit different traits on all level of use variables. The LUA frequency distribution data in Table 18 provides a clear indication of the differences in levels of use between the two jurisdictions with higher proportions of Jurisdiction Y teachers at both use category levels and less than half the proportion of Jurisdiction Y teachers at the non-use of computers category. The results confirm that Jurisdiction Y has been more successful at achieving integration of technology in instruction.

The t-tests in Table 21 also confirm that the two sub-groups exhibit different traits. The two groups exhibited significant differences on all research-based predictor variables with the exception of *Innovativeness*. Here as well Jurisdiction Y has been more successful at achieving higher levels of teacher self-competence and positive attitudes towards computer use.

The lack of a significant difference between jurisdictions for *Innovativeness* reflects the results for *Innovativeness* in Problem 2 where users at the utilization level were split according to electronic mail use or non-use. This suggests that innovativeness is an innate characteristic that is not affected by interventions such as electronic mail use or district support for technology. This conclusion is also supported by the positive correlation between *Home Computer* and *Innovativeness*, and the fact that the proportion of teachers in each founding jurisdiction that have home computers is not significantly different at 60.8% for Jurisdiction X and 61.1% for Jurisdiction Y. In other words, we have two populations whose level of innovativeness is equivalent and whose level of innovativeness correlates significantly and positively with their possession of a home computer, but whose level of innovativeness is unaffected by jurisdictional interventions that do produce significant differences in other predictor variables.

The gender mix of the two groups is also not significantly different (p=.8001). Age may have some influence on the differences exhibited between the two jurisdictions, since Jurisdiction X has a significantly older teaching force (p<.0001) and *Age* is significantly and negatively correlated with all four research based predictor variables. *Age* does not correlate significantly with the three of the four level ofuse variables that are derived from the data provided by computer users (*Integration*, *LCU 4-12*, and *Effect of Removal*). If age were the primary determinant one would expect the three level of use variables to be negatively correlated with age and expect *Innovativeness* to reflect the same differences between jurisdictions as the other three predictor variables, but it did not. Consequently age is not likely a determining factor for jurisdictional differences.

A more plausible explanation is that the significant differences between the two jurisdictions on the four level of use variables and the three research-based predictor variables is not due to innate differences in teachers, but is due to the difference in jurisdictional environments with respect to technology. These differences manifest themselves in district-level planning and support for technology that in turn has resulted in better access to computers and the establishment of electronic mail for teachers.

Ease of access to computers is generally high in both jurisdictions (87.0% vs. 97.4%), but the difference in computers actually at the personal workspace is much more striking (37.0% vs. 90.6%). Other factors include the fact that the district electronic mail system is only accessible in Jurisdiction Y, and historically a position with responsibility specifically for planning, implementation, coordination, and support for technology at central office has existed only in Jurisdiction Y.

Several positive comments were received from Jurisdiction Y teachers regarding support for technology use by teachers. Overall the results indicate that teachers in founding Jurisdiction Y integrate computers more, would be more significantly affected by removal of computers, have more positive affective and cognitive attitudes about computers, and feel more competent using computers.

Theoretical Relevance

In his use of the LUA, Marcinkiewicz (1994) concluded that it was possible to categorically assess the level of use of computers in a fashion consistent with the model of instructional transformation, and that there are personal variables that contribute to a teacher's level of computer use. This study corroborates Marcinkiewicz's finding including the positive correlational relationship between the level of use of computers and teachers' perceptions of self-competence and innovativeness. Two aspects of attitudes identified by Kay (1988) as contributing to commitment to the use of computers were also shown to correlate positively with the level of use of computers measured by the LUA.

This study was more concerned with identifying the nature of the relationship of an external variable that may influence the level of use of a computer either directly or indirectly by influencing other predictors of the level of computer use. The specific environmental factor being explored was the use of electronic mail (although other environmental factors such as jurisdiction, access to a computer, and possession of a home computer were also accounted for). The investigation revealed that *Self-Competence*, *Affective Attitudes*, and *Cognitive Attitudes* are manipulatable variables, but that innovativeness may be innate in nature and non-manipulatable.

Evidence was uncovered to suggest that pivotal applications (electronic mail in this case) and strategies that positively influence these previously identified variables may exist. It was shown that use of electronic mail may be predictive of higher levels of computer integration, but the true nature of the relationship of electronic mail to this variable is not completely clear from this study.

Measurement remains an issue. The primary and secondary data offer different pictures of the influence of electronic mail, leaving the exact nature of that influence, to some degree, speculative. The explanation of a curvilinear relationship fits the data, but the measurement techniques for levels of use (LUA measure) does not discriminate early adoption levels of use well enough to test this explanation.

Implications

From the evidence provided by this study, innovativeness would not appear to be manipulatable (however providing an environment where innovation can flourish may to be helpful in influencing other predictor variables). *Self-Competence*, *Cognitive Attitudes*, and *Affective Attitudes* were shown to be environmentally sensitive in that the provision of technology planning and support produced real differences in sub-groups on these scales.

The study is set within the context of three change agendas in education with the focus being specifically on technology integration. Acceptance of this framework includes acceptance of the notion that dramatic change in education due to the unilateral influences of restructuring, active learning, or technology integration is unlikely. In other words, a high level of integration of technology cannot be expected to ‘change the world’ on its own. It is, none-the-less considered to be a vital element in the overall change process. The implication is that integration of technology is a fundamental change that will have to evolve with learner-centred approaches to education and site-based decision making if public education is to silence the critics and ensure continued healthy support for a public education system that maintains relevance to student needs. The wider implication is that a commitment to changing traditional roles throughout the organization is required as student needs and teaching methods continue change. If the benefits of restructuring, active learning, and integration of technology are to accrue to students, the role the teacher plays will become even more instrumental in developing effective learning environments. The factors addressed in this study are prerequisites to this change in role. Teachers will need to integrate the best tools available (including computers) within an organizational structure modeled upon service to the classroom.

These new needs of students are not driven by a model of instruction that is designed simply to produce competent workers. While this is a worthy goal, education is much more than vocational preparation. Education’s role is to prepare students to be ethical, competent, and caring citizens that can fully and actively participate in a society increasingly dominated by the new information and communications technologies.

Recommendations

Further Research

Electronic mail was originally presented in this study as an application helpful in getting teachers started with computers by contributing positively to factors that influence the level of integration of computers in teaching. While this study did reveal that this effect exists, the true nature of the effect of electronic mail use remains obscured. The absence of any duration data and the coarse scale increments allowed by some measures may have prevented full exposure of this relationship. The results of this study suggest four further research initiatives are needed.

First, further research should be conducted that addresses the effects of electronic mail use on the level of integration over time. Since the primary data collection and analysis did not reveal as strong a relationship as was revealed in the secondary data collection, the effect of electronic mail use may be short term. Introduction of a temporal measure will allow discovery of the long term effects of electronic mail use on the level of integration of computers and on the predictor factors identified in the literature.

Second, refinement of the LUA is required to resolve the unacceptably high number of records that were excluded from the determination of the *LCU* variable due to respondents not following one of the two predicted response patterns. This issue is not specific to this study and will be present no matter what use the LUA is put to. It may be possible to successfully address this problem by revising the instructions to respondents rather than by making major modifications to the instrument structure.

Third, the inadequacy of the LUA to meet the needs of this study illustrates the need to develop a more effective measure of the Rieber and Welliver (1989) five level model of instructional transformation. The model of instructional transformation is ordinal in nature. It should be possible to develop a measure that provides a sufficiently fine-scaled interval measure of the level of technology integration. The LUA effectively measures the second and third level of the Rieber and Welliver model, but there is a mismatch at level one. Rescaling the LUA did allow for a finer increment between levels two and three, but it is between levels one and two that the effect being studied here is thought to have its greatest influence. A redesign of the LUA, or development of a new instrument that provided an interval measure over all five levels, would be beneficial for many researchers studying the effects of various interventions on the level of technology integration.

Fourth, the qualitative data differences between electronic mail users and non-users at the integration level illustrates the value of qualitative investigation techniques. The written comments made by integration level teachers indicated that their views on what constitutes essential or critical use of computers in teaching followed two distinctly different themes even though the LUA placed these teachers at the same level. This is an indication that quantifying the Rieber and Welliver model may prove difficult. Consequently an investigation of the level of computer use in instruction utilizing qualitative research methods should be undertaken.

Practical Application

Two practical recommendations come from this work. The first is that schools, jurisdictions, and provincial authorities should move quickly to equip teachers with computers and to connect these computers to a high-quality electronic mail system.

It is clearly evident from the secondary data that teachers with electronic mail overwhelmingly feel that their colleagues should have the same access. This data also strongly endorses the notion that electronic mail contributes a great deal to the level of self-competence in using computers felt by teachers. The primary data is less revealing of the relationship between use of electronic mail and integration of computers, but the relationship between self-competence and integration of computers is relatively clear from this and previous works. Investigation of the sub-groups of users segregated on the basis of their assignment level by the LUA indicated that electronic mail users have an edge with respect to progress towards integrated use of technology in instruction. The number of electronic mail using participants assigned to this level of integration is also disproportionately higher than non-users (63.9% of integration level users versus 40.2% of all computer users). Consequently it can be concluded that use of the district's electronic mail system did have a significant effect on teacher use of computers.

The 80% response rate to the secondary data instrument within a 24 hour period is powerful evidence that teachers with district electronic mail IDs use the system on a routine basis. This effective demonstration of the power of the system to facilitate rapid and effective communications is a strong endorsement of the desire of these respondents to have the service extended to their peers.

The modern personal computer has increasingly assumed a major role as a communications device. In early instances this role was chiefly fulfilled by enhancing the ability to produce traditional forms of communication such as paper documents or graphic presentations. More recently though, the computer has allowed new forms of communications such as electronic mail and computer conferencing. Electronic mail provides a new communications ability that did not exist before the advent of computers. Electronic mail is only one, although probably the currently most important one, of the new forms of computer mediated communication that have become available on networks. Electronic mail reduces, or even eliminates, the barriers of time and space, allowing people to communicate and share with ease across the hall or across the district. For these reasons alone, electronic mail is a good thing. But the likelihood that it also predictive of higher levels of self-competence and integration of computers supports the implementation of electronic mail for all teachers.

The second recommendation is that provisions should be made to ensure professional and technical resources are available to effectively plan technology deployment, and to support technology use, either at the provincial level, or at the jurisdiction level.

The emergence of significant differences between the two sub-groups based on founding jurisdictions points out the value of central office support for technology. As the three change agendas outlined by Sheingold (1991) accelerate the adoption of technology tools, the level of sophistication and the need for support services for school systems and teachers will increase. The electronic mail system in Jurisdiction Y connects the majority of classrooms in the jurisdiction. Extending electronic mail systems beyond the walls of a given school requires increased technical expertise and coordination. There is no evidence to suggest that the use of electronic mail will not continue to grow, and support services will facilitate this growth. These support services must comply with Sheingold's role description for central office "rather than telling schools how to do what they must do, the central office can help them get things done" (Sheingold, 1991, p. 21).

Conclusions

The results suggest that progress towards the goal of full integration of technology is slow. This is tempered by the fact that jurisdictional differences indicate that progress has been made toward integration of technology where support resources have been provided. Still, full integration of technology appears to be a distant goal.

Unilateral actions supporting the integration of technology cannot be expected to achieve technology's potential. If Sheingold (1991) is correct, we should not expect rapid integration of technology unless progress is concurrently made in the area of restructuring and the movement towards learner-control environments. Major innovations are unlikely to be achieved under current structures if as Fullan says, "Staff development will never have its intended impact as long as it is grafted onto schools in the form of discrete, unconnected projects" (Fullan, 1990, p. 21). The jury is still out on whether or not the current restructuring effort in Alberta will achieve any significant change at the school level.

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Appendix A: The Computer Use Questionnaire

Computer Use Questionnaire

Why? This survey is designed to gather information that will help teacher's take advantage of technology. The information obtained will be used to help assess the needs of teachers regarding the use of computers in the classroom.

Since you, the professional teacher, are the crucial facilitator of our education system, I feel it is critically important to obtain your valuable input. It is equally important to understand the opinions of non-computer users as it is the opinions of computer users.

Participation Completing this survey should take **less than 10 minutes**. Your participation is completely optional. If you should decide not to complete the survey, would you please indicate why in the space provided below?

____

____

Confidentiality Please **do not** put your name on the survey. The results will remain completely confidential. An envelope tracking system is being used to ensure sufficient participation. I personally guarantee that the tracking information will be discarded **before** your responses are analyzed. As a further safeguard (even though it should not be possible to identify a respondent from the raw data) only a research assistant and I will ever have access to the raw data. The final report will be the only information shared with the regional division and others.

Instructions The survey consists of 4 sections. Please read the following "reminders" to insure that your responses are complete and accurate.

1. Read all questions carefully.
2. Please answer all questions.
3. Don't spend too long on any one question.

When you are finished, please fold the survey in half, seal it in the enclosed self-addressed envelope, and return it to the box provided in your school office prior to April 7, 1995.

Thank You I sincerely appreciate your taking the time and careful consideration required to complete this survey. I assure you that your effort will not be wasted.

Results will be available at all division schools soon after the study has been completed. (Prior to the end of 1995.)

Once again my sincere thanks,

Gary Spence

Section 1: *For each of the following 10 items, please circle the appropriate number.*

Choosing 1 means the adjective on the left very accurately represents your view. Choosing 7 means the adjective on the right very accurately represents your view.

I feel my experience using a computer is (or would be):

1.	Unpleasant	1	2	3	4	5	6	7	Pleasant
2.	Interesting	1	2	3	4	5	6	7	Boring
3.	Cold	1	2	3	4	5	6	7	Warm
4.	Likable	1	2	3	4	5	6	7	Unlikable
5.	Suffocating	1	2	3	4	5	6	7	Fresh
6.	Sociable	1	2	3	4	5	6	7	Unsociable
7.	Uncomfortable	1	2	3	4	5	6	7	Comfortable
8.	Calm	1	2	3	4	5	6	7	Tense
9.	Dull	1	2	3	4	5	6	7	Exciting
10.	Personal	1	2	3	4	5	6	7	Impersonal

Thank you. Please proceed to Section 2…

Appendix A: The Computer Use Questionnaire

Section 2: *Please read the following statements. To what degree do you believe that each statement is true about you?*

Please circle the number which most closely corresponds to your degree of agreement.	Strongly Agree	Agree	Slightly Agree	Neutral	Slightly Disagree	Disagree	Strongly Disagree
11. I am generally cautious about accepting new ideas.	1	2	3	4	5	6	7
12. I rarely trust new ideas until I can see whether the vast majority of people around me accept them.	1	2	3	4	5	6	7
13. I am aware that I am usually one of the last people in my group to accept something new.	1	2	3	4	5	6	7
14. I am reluctant about adopting new ways of doing things until I see them working for people around me.	1	2	3	4	5	6	7
15. I find it stimulating to be original in my thinking and behaviour.	1	2	3	4	5	6	7
16. I tend to feel the tried and proven ways of doing things are still the best ways.	1	2	3	4	5	6	7
17. I am challenged by ambiguities and unsolved problems.	1	2	3	4	5	6	7
18. I must see other people successfully using new innovations before I will consider adopting them.	1	2	3	4	5	6	7
19. I am challenged by unanswered questions.	1	2	3	4	5	6	7
20. I often find myself skeptical of new ideas.	1	2	3	4	5	6	7
21. I believe that the use of computers is relevant to teaching.	1	2	3	4	5	6	7
22. I believe that the use of computers is relevant to student learning in almost all subject areas.	1	2	3	4	5	6	7
23. I believe that the use of computers is relevant to my students' adult lives.	1	2	3	4	5	6	7
24. I believe that I am capable of using a computer competently.	1	2	3	4	5	6	7

Thank you for your effort so far. This was the longest section. There are only two short sections remaining. Please continue…

Section 3: *Please tell me a little about your use of the computer in instruction.*

Circle Y for Yes; Circle N for No.

25. Do you personally use a computer?	Y N

If you answered NO to question 25, skip the rest of this section and proceed directly to Section 4.

For items 26 to 29, select the one statement that is the most true about you.

Special note to secondary teachers: *Some junior and senior high school courses are computer-specific (e.g. Computer Studies; many CTS courses). If you teach computer-specific courses please answer the following section based on the other types of courses you teach (e.g. Math, Social Studies, Language Arts, etc.). If you only teach computer-specific courses, answer the section based on what you expect would be most true if you did teach other non-computer-specific courses.*

For each pair of statements, circle either A or B. If you do not use a computer, circle N in Question 25 and proceed to Section 4.

Circle A if *The first statement is* ***Most*** *True*	*Circle B if* *The second statement is* ***Most*** *True*

26. *First Statement:* In my instruction, the use of the computer is supplemental.	A
Second Statement: The computer is critical to the functioning of my instruction.	B
27. *First Statement:* The use of the computer is not essential in my instruction.	A
Second Statement: For my teaching, the use of the computer is indispensable.	B
28. *First Statement:* The computer is critical to the functioning of my instruction.	A
Second Statement: The use of the computer is not essential in my instruction.	B
29. *First Statement:* For my teaching, the use of the computer is indispensable.	A
Second Statement: In my instruction, the use of the computer is supplemental.	B

Thank you again. There is only one section remaining. Please proceed...

Section 4: *Please tell me a little about your experience with electronic mail.*

30. Which statement best describes your personal experience with Electronic Mail. ***(Circle 1, 2, 3, or 4).***
    - I don't know what Electronic Mail is. 1
    - I've heard of Electronic Mail but have never used it. 2
    - I sometimes use Electronic Mail 3
    - I regularly use Electronic Mail 4

For questions 31-34, circle Y for Yes, circle N for No.

31. Do you have, or have you had, an account or ID on a commercial on-line service, the Internet, or a non-commercial bulletin board service (BBS). (If you don't know what this means, answer No.) .... Y N
32. Do you have a computer at home? .... Y N
33. Have you heard of the *(school division's)* electronic mail system? .... Y N
34. Do you use the *(school division's)* electronic mail system? .... Y N

For questions 35-37, circle the appropriate response.
If you answered no to Question 34, skip to Question 36.

35. On average, how often do you use the *(school division's)* electronic mail system?
    - Less than 5 times per week 1
    - Between 5 and 25 times per week 2
    - Over 25 times per week. 3

36. If you decided to use a computer at school, which response best describes your ease of access to a computer?
    - I have a computer in my classroom or school office 1
    - I don't have a computer in my classroom or school office but I have easy access to a computer in the school. 2
    - I don't have a computer in my classroom or school office and it is not easy for me to access a computer in the school. 3
    - I have no access to a computer at school. 4

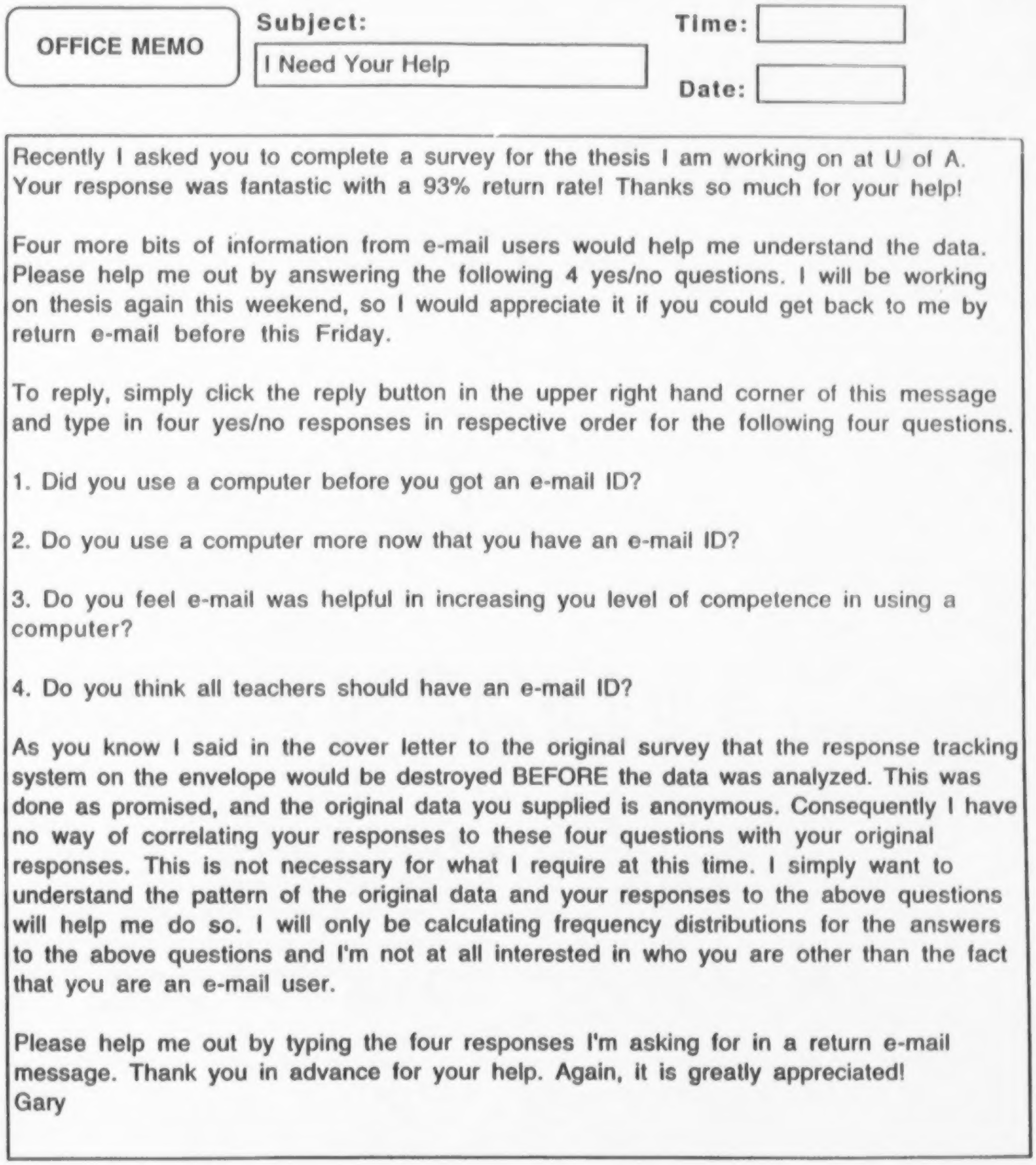
37. Complete this statement based on what you believe to be most true. "If all of the computers were suddenly removed from my school…
    - …it would have a significant impact on the way I teach." 1
    - …it would have little impact on the way I teach." 2
    - …it would have no impact on the way I teach." 3

38. Please use the back of this sheet to provide any written comments that you feel would add to my understanding of your thoughts.

Thank you for your valuable input. Your help is certainly appreciated.

Appendix A: The Computer Use Questionnaire

Appendix B: Follow-up Data Collection Instrument



OFFICE MEMO

Subject: I Need Your Help

Time:

Date:

Recently I asked you to complete a survey for the thesis I am working on at U of A. Your response was fantastic with a 93% return rate! Thanks so much for your help!

Four more bits of information from e-mail users would help me understand the data. Please help me out by answering the following 4 yes/no questions. I will be working on thesis again this weekend, so I would appreciate it if you could get back to me by return e-mail before this Friday.

To reply, simply click the reply button in the upper right hand corner of this message and type in four yes/no responses in respective order for the following four questions.

1. Did you use a computer before you got an e-mail ID?

2. Do you use a computer more now that you have an e-mail ID?

3. Do you feel e-mail was helpful in increasing you level of competence in using a computer?

4. Do you think all teachers should have an e-mail ID?

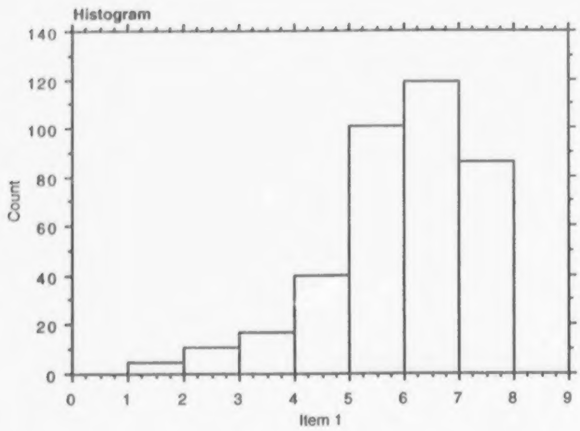
As you know I said in the cover letter to the original survey that the response tracking system on the envelope would be destroyed BEFORE the data was analyzed. This was done as promised, and the original data you supplied is anonymous. Consequently I have no way of correlating your responses to these four questions with your original responses. This is not necessary for what I require at this time. I simply want to understand the pattern of the original data and your responses to the above questions will help me do so. I will only be calculating frequency distributions for the answers to the above questions and I'm not at all interested in who you are other than the fact that you are an e-mail user.

Please help me out by typing the four responses I'm asking for in a return e-mail message. Thank you in advance for your help. Again, it is greatly appreciated!
Gary

Appendix B: Secondary Data Collection Instrument

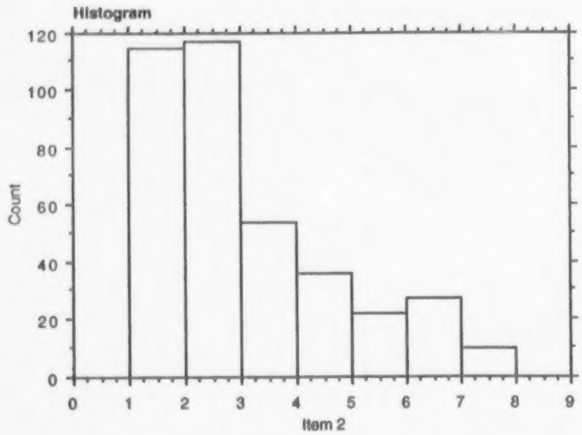
Appendix C: Items of the Computer Use Questionnaire

Affective Attitudes Items



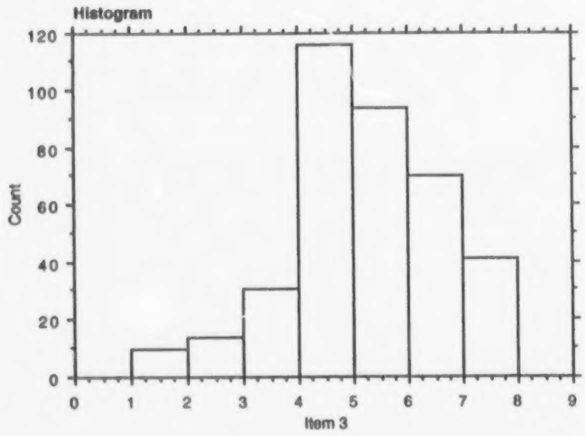
Frequency Distribution for Item 1

From (≥)	To (<)	Count	Percent
1.000	2.000	5	1.319
2.000	3.000	11	2.902
3.000	4.000	17	4.485
4.000	5.000	40	10.554
5.000	6.000	101	26.649
6.000	7.000	119	31.398
7.000	8.000	86	22.691
	Total	379	100.000



Frequency Distribution for Item 2

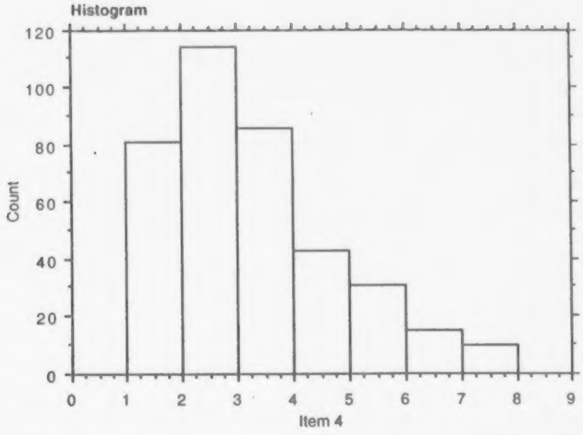
From (≥)	To (<)	Count	Percent
1.000	2.000	115	30.184
2.000	3.000	117	30.709
3.000	4.000	54	14.173
4.000	5.000	36	9.449
5.000	6.000	22	5.774
6.000	7.000	27	7.087
7.000	8.000	10	2.625
	Total	381	100.000



Frequency Distribution for Item 3

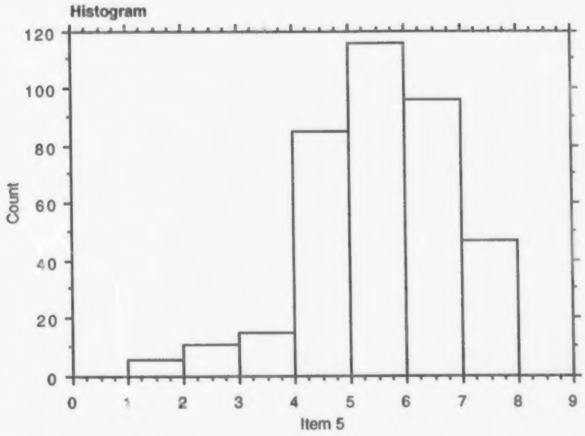
From (≥)	To (<)	Count	Percent
1.000	2.000	10	2.660
2.000	3.000	14	3.723
3.000	4.000	31	8.245
4.000	5.000	116	30.851
5.000	6.000	94	25.000
6.000	7.000	70	18.617
7.000	8.000	41	10.904
	Total	376	100.000

Appendix C: Descriptive Statistics and Histograms for items of the Computer Use Questionnaire



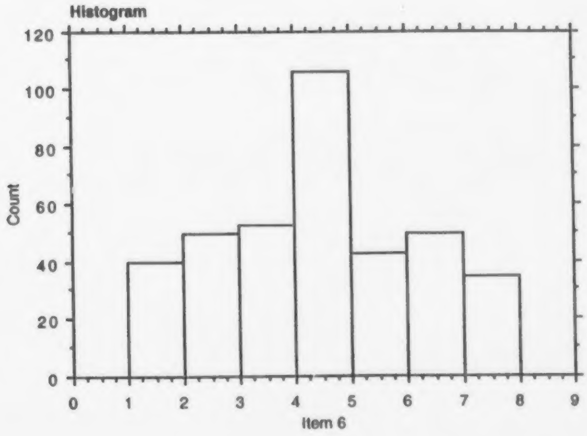
Frequency Distribution for Item 4

From (≥)	To (<)	Count	Percent
1.000	2.000	81	21.316
2.000	3.000	114	30.000
3.000	4.000	86	22.632
4.000	5.000	43	11.316
5.000	6.000	31	8.158
6.000	7.000	15	3.947
7.000	8.000	10	2.632
	Total	380	100.000



Frequency Distribution for Item 5

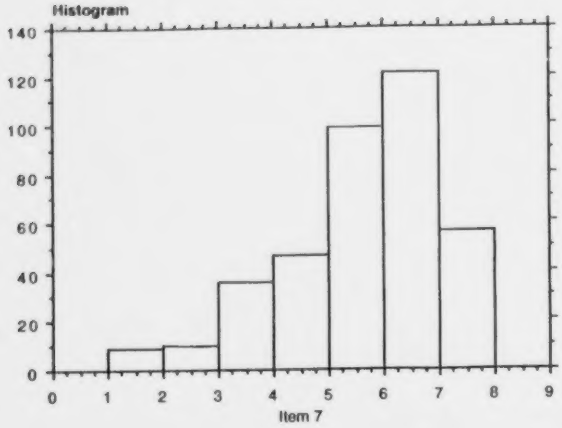
From (≥)	To (<)	Count	Percent
1.000	2.000	6	1.596
2.000	3.000	11	2.926
3.000	4.000	15	3.989
4.000	5.000	85	22.606
5.000	6.000	116	30.851
6.000	7.000	96	25.532
7.000	8.000	47	12.500
	Total	376	100.000



Frequency Distribution for Item 6

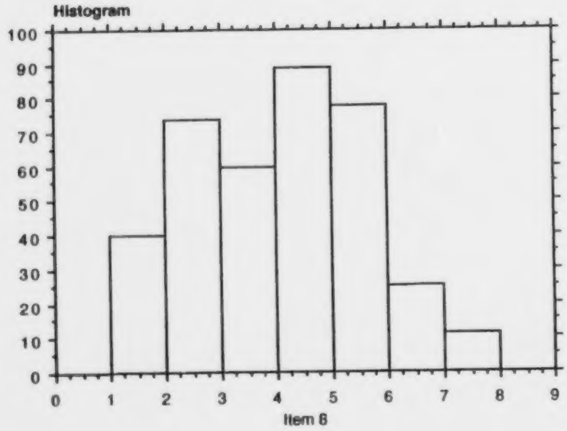
From (≥)	To (<)	Count	Percent
1.000	2.000	40	10.610
2.000	3.000	50	13.263
3.000	4.000	53	14.058
4.000	5.000	106	28.117
5.000	6.000	43	11.406
6.000	7.000	50	13.263
7.000	8.000	35	9.284
	Total	377	100.000

Appendix C: Descriptive Statistics and Histograms for items of the Computer Use Questionnaire



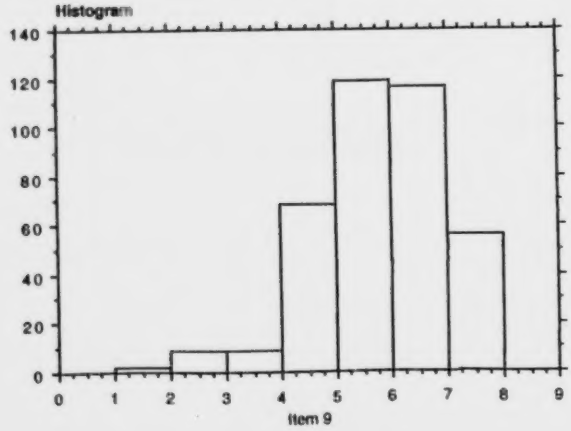
Frequency Distribution for Item 7

From (≥)	To (<)	Count	Percent
1.000	2.000	9	2.381
2.000	3.000	10	2.646
3.000	4.000	36	9.524
4.000	5.000	47	12.434
5.000	6.000	99	26.190
6.000	7.000	121	32.011
7.000	8.000	56	14.815
	Total	378	100.000



Frequency Distribution for Item 8

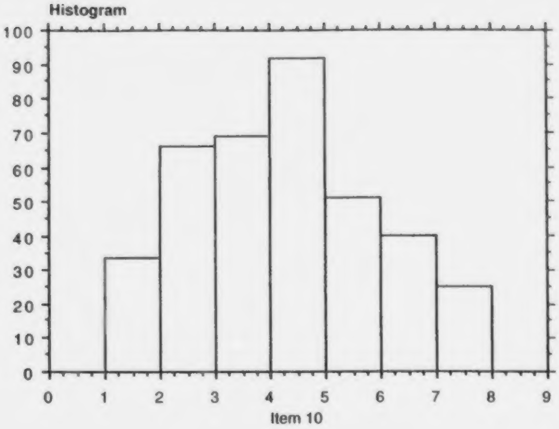
From (≥)	To (<)	Count	Percent
1.000	2.000	40	10.610
2.000	3.000	74	19.629
3.000	4.000	60	15.915
4.000	5.000	89	23.607
5.000	6.000	78	20.690
6.000	7.000	25	6.631
7.000	8.000	11	2.918
	Total	377	100.000



Frequency Distribution for Item 9

From (≥)	To (<)	Count	Percent
1.000	2.000	2	.528
2.000	3.000	9	2.375
3.000	4.000	9	2.375
4.000	5.000	68	17.942
5.000	6.000	119	31.398
6.000	7.000	116	30.607
7.000	8.000	56	14.776
	Total	379	100.000

Appendix C: Descriptive Statistics and Histograms for items of the Computer Use Questionnaire



Frequency Distribution for Item 10

From (≥)	To (<)	Count	Percent
1.000	2.000	34	9.019
2.000	3.000	66	17.507
3.000	4.000	69	18.302
4.000	5.000	92	24.403
5.000	6.000	51	13.528
6.000	7.000	40	10.610
7.000	8.000	25	6.631
	Total	377	100.000

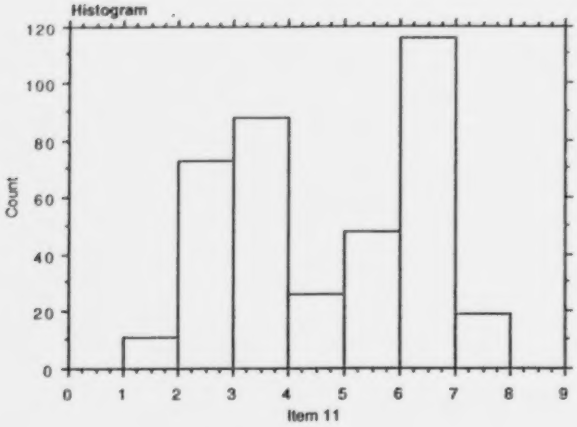
Descriptive Statistics

	Affective Att
Mean	48.855
Std. Dev.	10.834
Std. Error	.556
Count	380
Minimum	10.000
Maximum	70.000
# Missing	0

Note: Alternating items had the differential scale inverted. These item scales were reinverted prior to calculating the Affective Attitudes scale score.

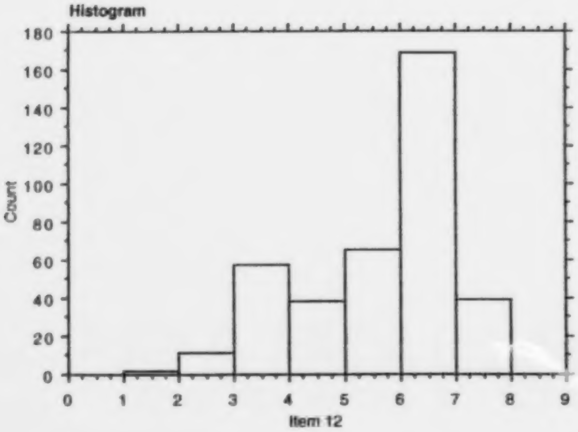
Appendix C: Descriptive Statistics and Histograms for items of the Computer Use Questionnaire

Innovativeness Items



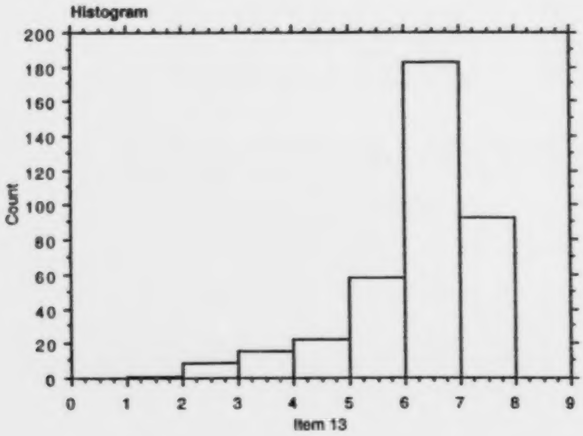
Frequency Distribution for Item 11

From (≥)	To (<)	Count	Percent
1.000	2.000	11	2.887
2.000	3.000	73	19.160
3.000	4.000	88	23.097
4.000	5.000	26	6.824
5.000	6.000	48	12.598
6.000	7.000	116	30.446
7.000	8.000	19	4.987
	Total	381	100.000



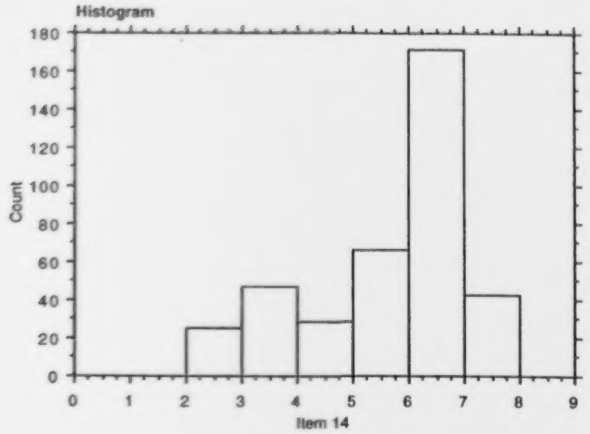
Frequency Distribution for Item 12

From (≥)	To (<)	Count	Percent
1.000	2.000	2	.525
2.000	3.000	11	2.887
3.000	4.000	57	14.961
4.000	5.000	38	9.974
5.000	6.000	65	17.060
6.000	7.000	169	44.357
7.000	8.000	39	10.236
	Total	381	100.000



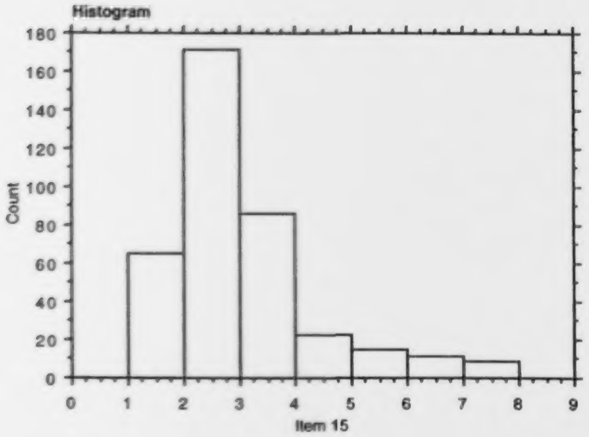
Frequency Distribution for Item 13

From (≥)	To (<)	Count	Percent
1.000	2.000	1	.262
2.000	3.000	9	2.362
3.000	4.000	15	3.937
4.000	5.000	22	5.774
5.000	6.000	58	15.223
6.000	7.000	183	48.031
7.000	8.000	93	24.409
	Total	381	100.000



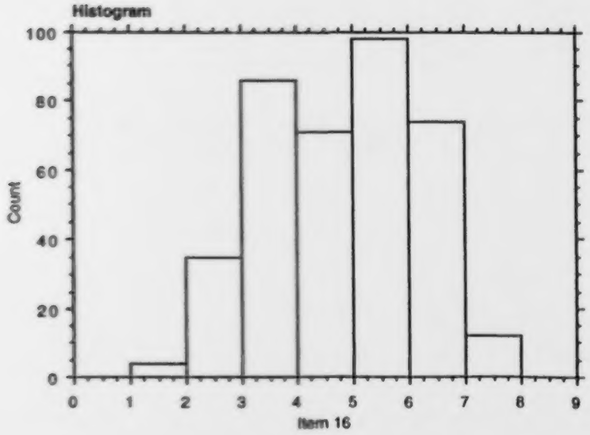
Frequency Distribution for Item 14

From (≥)	To (<)	Count	Percent
1.000	2.000	0	0.000
2.000	3.000	25	6.562
3.000	4.000	47	12.336
4.000	5.000	29	7.612
5.000	6.000	66	17.323
6.000	7.000	171	44.882
7.000	8.000	43	11.286
	Total	381	100.000



Frequency Distribution for Item 15

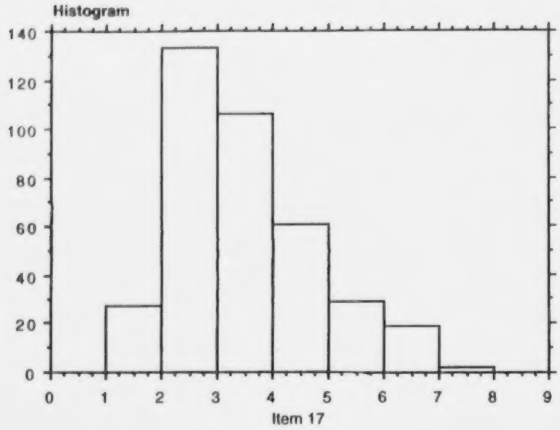
From (≥)	To (<)	Count	Percent
1.000	2.000	65	17.060
2.000	3.000	171	44.882
3.000	4.000	86	22.572
4.000	5.000	23	6.037
5.000	6.000	15	3.937
6.000	7.000	11	2.887
7.000	8.000	9	2.362
	Total	380	99.738



Frequency Distribution for Item 16

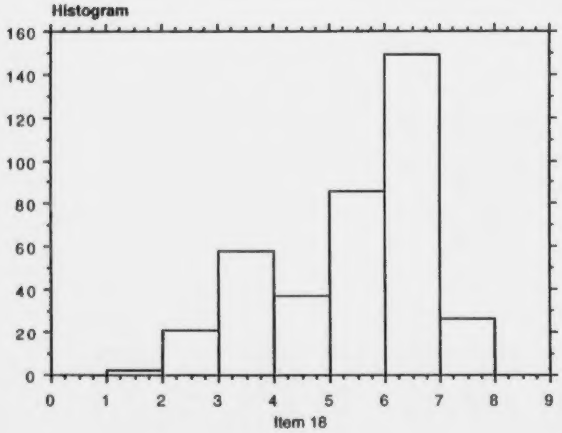
From (≥)	To (<)	Count	Percent
1.000	2.000	4	1.053
2.000	3.000	35	9.211
3.000	4.000	86	22.632
4.000	5.000	71	18.684
5.000	6.000	98	25.789
6.000	7.000	74	19.474
7.000	8.000	12	3.158
	Total	380	100.000

Appendix C: Descriptive Statistics and Histograms for items of the Computer Use Questionnaire



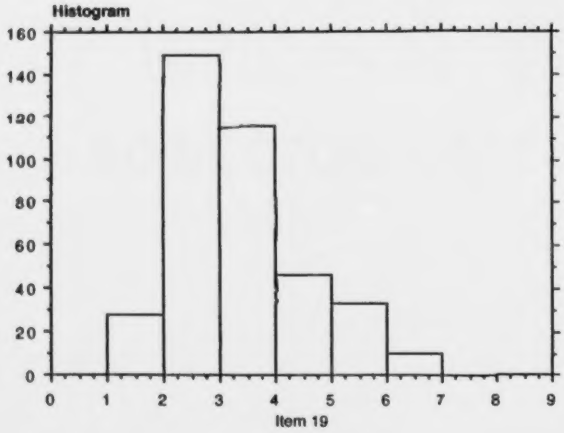
Frequency Distribution for Item 17

From (≥)	To (<)	Count	Percent
1.000	2.000	28	7.407
2.000	3.000	133	35.185
3.000	4.000	106	28.042
4.000	5.000	61	16.138
5.000	6.000	29	7.672
6.000	7.000	19	5.026
7.000	8.000	2	.529
	Total	378	100.000



Frequency Distribution for Item 18

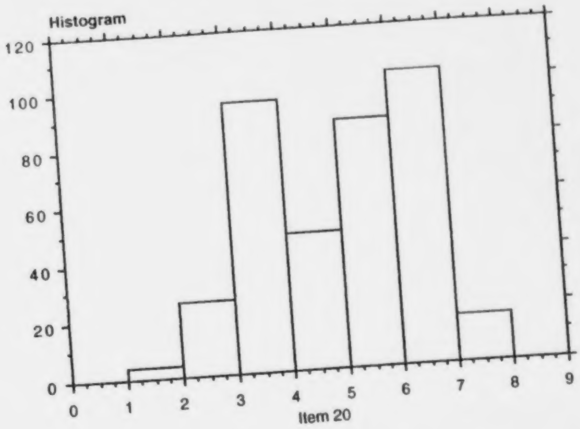
From (≥)	To (<)	Count	Percent
1.000	2.000	2	.528
2.000	3.000	21	5.541
3.000	4.000	58	15.303
4.000	5.000	37	9.763
5.000	6.000	86	22.691
6.000	7.000	149	39.314
7.000	8.000	26	6.860
	Total	379	100.000



Frequency Distribution for Item 19

From (≥)	To (<)	Count	Percent
1.000	2.000	28	7.349
2.000	3.000	149	39.108
3.000	4.000	115	30.184
4.000	5.000	46	12.073
5.000	6.000	33	8.661
6.000	7.000	10	2.625
7.000	8.000	0	0.000
	Total	381	100.000

Appendix C: Descriptive Statistics and Histograms for items of the Computer Use Questionnaire



Frequency Distribution for Item 20

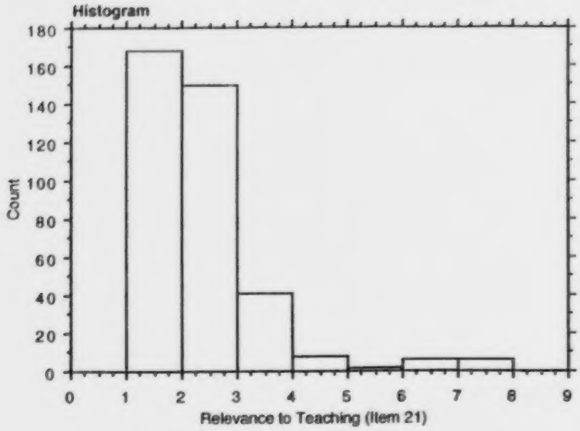
From (≥)	To (<)	Count	Percent
1.000	2.000	4	1.055
2.000	3.000	26	6.860
3.000	4.000	95	25.066
4.000	5.000	48	12.665
5.000	6.000	87	22.955
6.000	7.000	103	27.177
7.000	8.000	16	4.222
	Total	379	100.000

Descriptive Statistics

	Innovativeness
Mean	49.634
Std. Dev.	8.436
Std. Error	.433
Count	380
Minimum	25.000
Maximum	70.000
# Missing	0

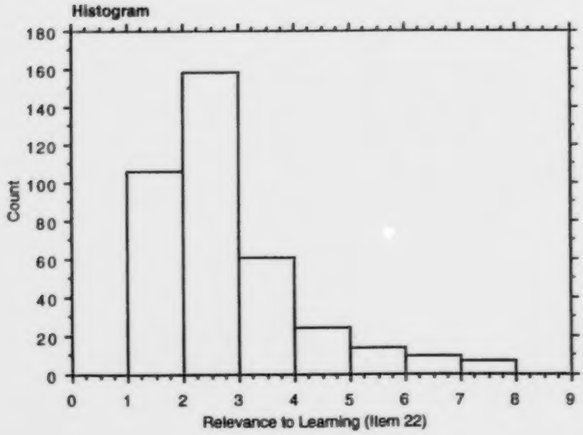
Note: Some items had the Liekert scale inverted. These item scales were reinverted prior to calculating the Innovativeness scale score.

Cognitive Attitudes (Relevance) Items



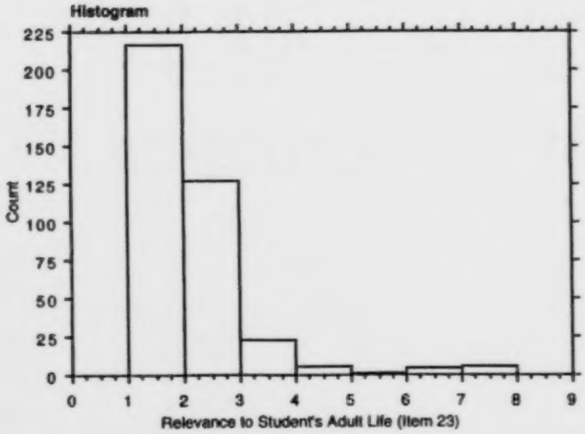
Frequency Distribution for Item 21

From (≥)	To (<)	Count	Percent
1.000	2.000	168	44.094
2.000	3.000	150	39.370
3.000	4.000	41	10.761
4.000	5.000	8	2.100
5.000	6.000	2	.525
6.000	7.000	6	1.575
7.000	8.000	6	1.575
	Total	381	100.000



Frequency Distribution for Item 22

From (≥)	To (<)	Count	Percent
1.000	2.000	106	27.895
2.000	3.000	158	41.579
3.000	4.000	61	16.053
4.000	5.000	24	6.316
5.000	6.000	14	3.684
6.000	7.000	10	2.632
7.000	8.000	7	1.842
	Total	380	100.000



Frequency Distribution for Item 23

From (≥)	To (<)	Count	Percent
1.000	2.000	216	56.693
2.000	3.000	127	33.333
3.000	4.000	23	6.037
4.000	5.000	5	1.312
5.000	6.000	1	.262
6.000	7.000	4	1.050
7.000	8.000	5	1.312
	Total	381	100.000

Descriptive Statistics

	Cognitive Att
Mean	18.168
Std. Dev.	3.167
Std. Error	.162
Count	380
Minimum	3.000
Maximum	21.000
# Missing	0

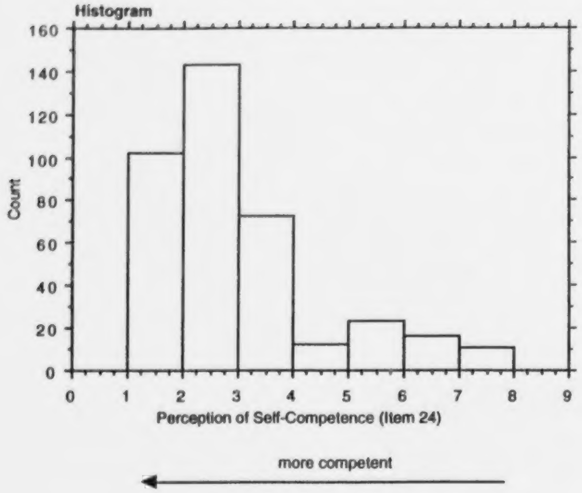
Fisher's r to z

	Correlation	P-Value
Cognitive Att, Relevance to...	.899	<.0001
Cognitive Att, Relevance to...	.911	<.0001
Cognitive Att, Relevance to...	.865	<.0001
Relevance to Teach, Releva...	.726	<.0001
Relevance to Teach, Releva...	.687	<.0001
Relevance to Learn, Releva...	.671	<.0001

The high degree of correlation between all three subscale items suggest that it may have not been necessary to add the two items that were added to Marcinkiewicz's original Percieved Relevance Scale.

Appendix C: Descriptive Statistics and Histograms for items of the Computer Use Questionnaire

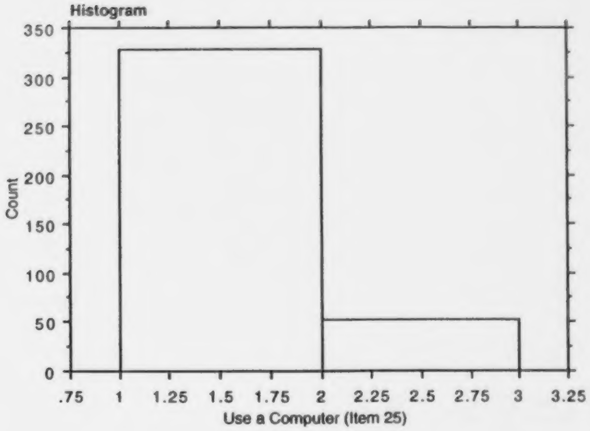
Self Competence Item



Frequency Distribution for Item 24

From (≥)	To (<)	Count	Percent
1.000	2.000	102	26.842
2.000	3.000	143	37.632
3.000	4.000	73	19.211
4.000	5.000	12	3.158
5.000	6.000	23	6.053
6.000	7.000	16	4.211
7.000	8.000	11	2.895
	Total	380	100.000

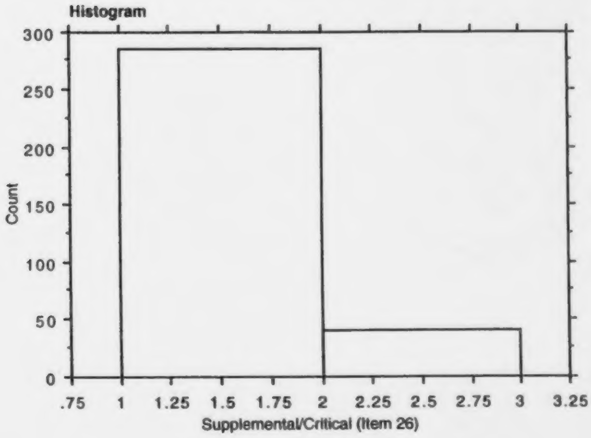
Levels of Use Assessment (LUA) Items



Frequency Distribution for Item 25

From (≥)	To (<)	Count	Percent
1.000	2.000	328	86.316
2.000	3.000	52	13.684
	Total	380	100.000

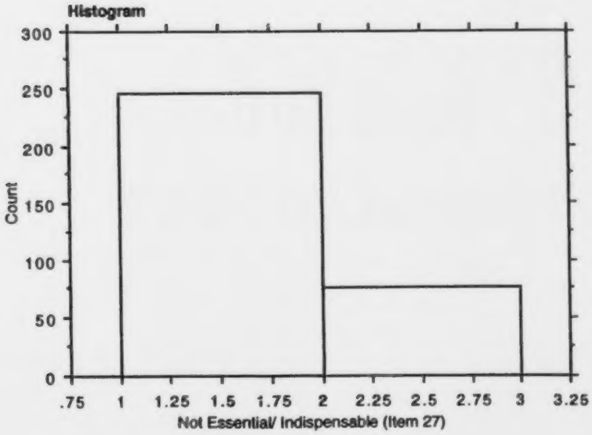
Key:
1 = Use a computer
2 = Do not use a computer



Frequency Distribution for Item 26

From (≥)	To (<)	Count	Percent
1.000	2.000	285	87.423
2.000	3.000	41	12.577
	Total	326	100.000

Key:
1 = Supplemental
2 = Critical

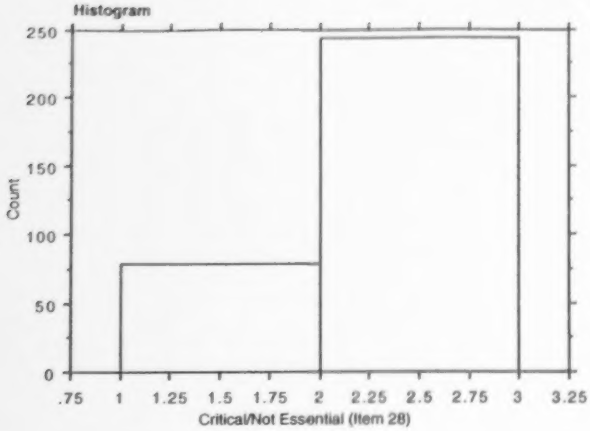


Frequency Distribution for Item 27

From (≥)	To (<)	Count	Percent
1.000	2.000	247	76.235
2.000	3.000	77	23.765
	Total	324	100.000

Key:
1 = Not essential
2 = Indispensable

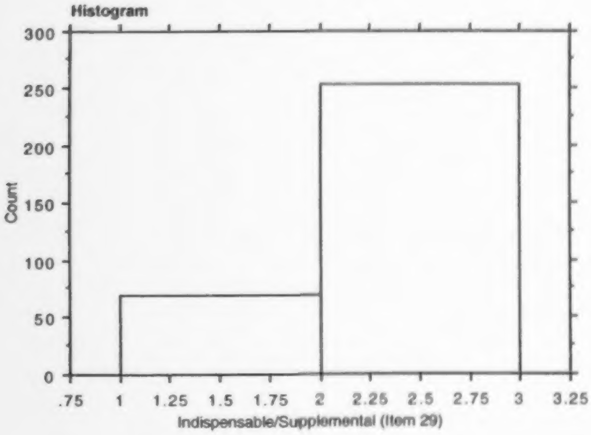
Appendix C: Descriptive Statistics and Histograms for items of the Computer Use Questionnaire



Frequency Distribution for Item 28

From (≥)	To (<)	Count	Percent
1.000	2.000	79	24.458
2.000	3.000	244	75.542
	Total	323	100.000

Key:
1 = Critical
2 = Not essential

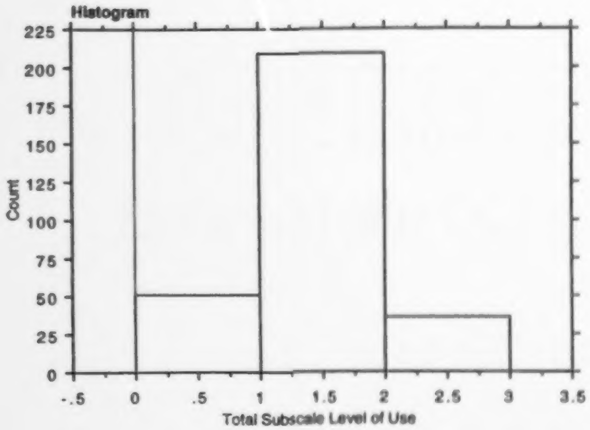


Frequency Distribution for Item 29

From (≥)	To (<)	Count	Percent
1.000	2.000	70	21.605
2.000	3.000	254	78.395
	Total	324	100.000

Key:
1 = Indispensable
2 = Supplemental

Level of Computer Use (LCU)



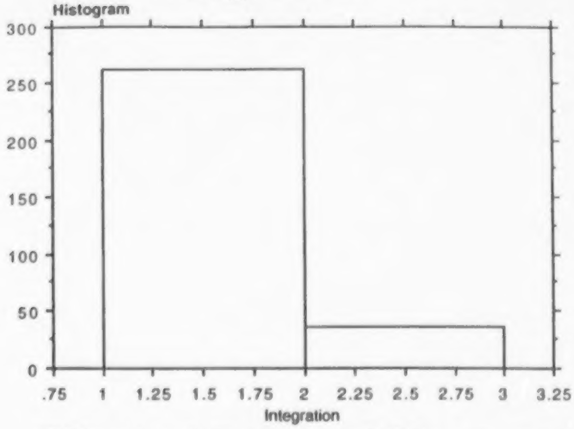
Frequency Distribution for Level of Computer Use

From (≥)	To (<)	Count	Percent
0.000	1.000	51	17.230
1.000	2.000	209	70.608
2.000	3.000	36	12.162
	Total	296	100.000

Key:
1 = Do not Use
2 = Utilization
3 = Integration

The purpose of the Level of Use variable was to classify teachers use of computers as either non use, utilization, or integration.

Integration



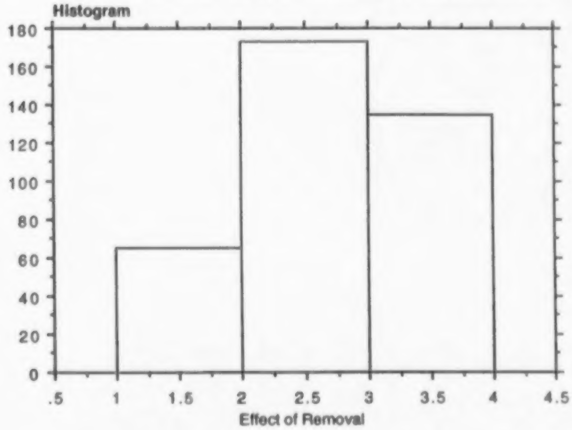
Frequency Distribution for Integration

From (≥)	To (<)	Count	Percent
1.000	2.000	262	87.919
2.000	3.000	36	12.081
	Total	298	100.000

Key:
1 = Not Integrated
2 = Integrated

Effect of Removal Measure (Descriptive)

The Design of the Level of Use measure allows for the prediction of two patterns of response. All other patterns of response indicate inconsistency. Item 37 was added to echo the criteria of expendability measured in the Level of Use Instrument. Item 37 is less restrictive in response patterns and may be substituted as a measure of expendability.



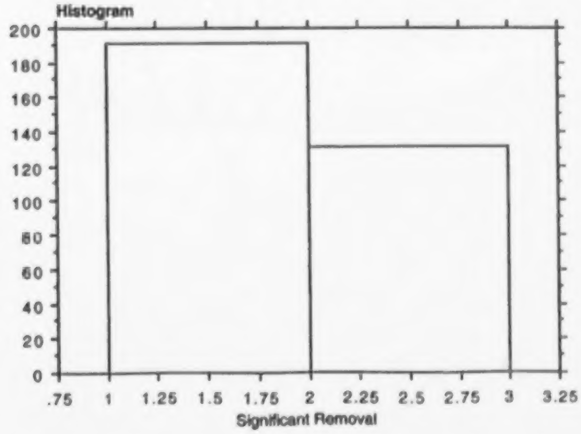
Frequency Distribution for Effect of Removal

From (≥)	To (<)	Count	Percent
1.000	2.000	65	17.426
2.000	3.000	173	46.381
3.000	4.000	135	36.193
	Total	373	100.000

Key:
1 = No Impact
2 = Little Impact
3 = Significant Impact

The Effect of Removal variable is intended to measure expendability of computer use. The critical factor is whether or not the computer is critical. There for the categories of little and no impact are combined for analysis.

Removal



Frequency Distribution for Removal

From (≥)	To (<)	Count	Percent
1.000	2.000	191	59.317
2.000	3.000	131	40.683
	Total	322	100.000

Key:
1 = Little or No Impact
2 = Significant Impact

Appendix C: Descriptive Statistics and Histograms for items of the Computer Use Questionnaire

Correlation Matrix

	Significant Removal	Integrated
Significant Removal	1.000	.515
Integrated	.515	1.000

Counts

	Significant Removal	Integrated
Significant Removal	322	241
Integrated	241	296

The less-than-expected correlation between the two variables suggest that they are not measuring the same criteria of expendability. The fact that the correlation is not higher than it may be explained by the fact that more respondents felt that removal of computers would have a significant effect than respondents that fit the Integrated pattern of response in the Levels of Use Assessment. The choice of terms used in the Instruments may have contributed to this. The Level of Use Assessment (Integrated) forces respondents into a specific pattern using strong adjectives (critical, indispensable). The measure of Effect of Removal use a milder term (would have a significant effect). Respondents may have been more willing to admit that removal of computers would have a significant effect than to indicate that the use of the computer was indispensable or critical to their instruction.

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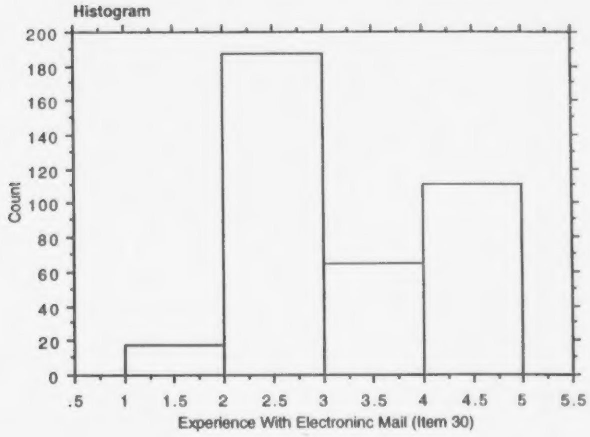
	Correlation	P-Value
Significant Removal, Integr...	.515	<.0001

Appendix C: Descriptive Statistics and Histograms for items of the Computer Use Questionnaire

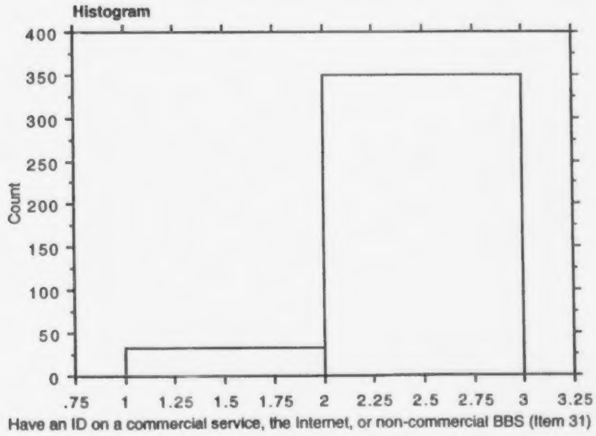
Section Four Items



Frequency Distribution for Item 30

From (≥)	To (<)	Count	Percent
1.000	2.000	17	4.474
2.000	3.000	187	49.211
3.000	4.000	65	17.105
4.000	5.000	111	29.211
	Total	380	100.000

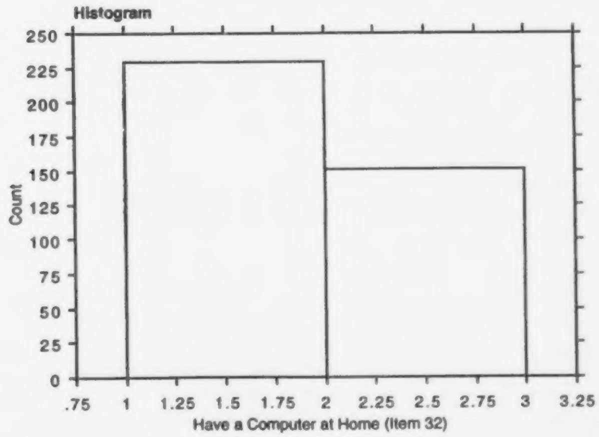
Key
1 = Don't know what e-mail is
2 = Heard of e-mail but never use
3 = Use sometimes
4 = Use regularly



Frequency Distribution for Item 31

From (≥)	To (<)	Count	Percent
1.000	2.000	32	8.377
2.000	3.000	350	91.623
	Total	382	100.000

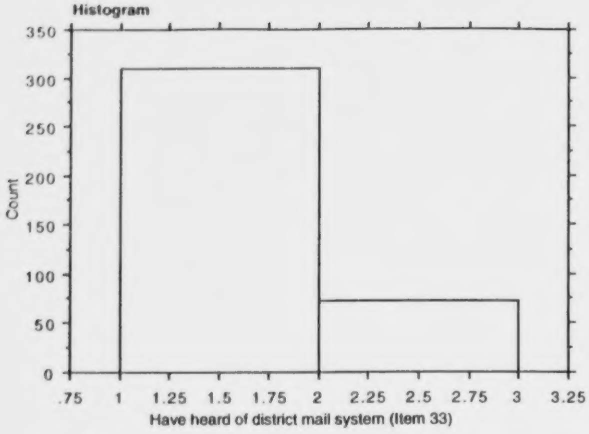
Key
1 = Have an ID other than District
2 = Do not Have ID



Frequency Distribution for Item 32

From (≥)	To (<)	Count	Percent
1.000	2.000	230	60.367
2.000	3.000	151	39.633
	Total	381	100.000

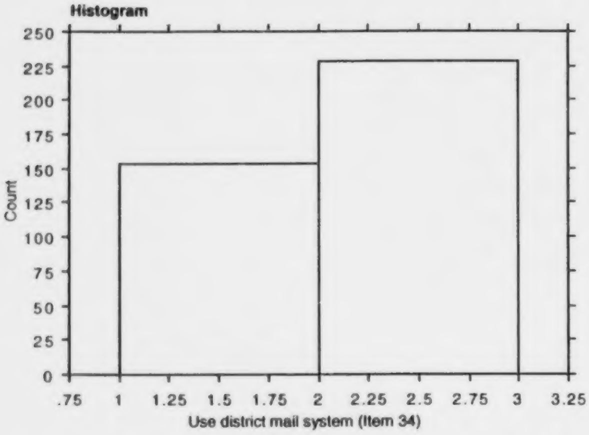
Key
1 = Have a computer at home
2 = Do not have a computer at home



Frequency Distribution for Item 33

From (≥)	To (<)	Count	Percent
1.000	2.000	309	80.890
2.000	3.000	73	19.110
	Total	382	100.000

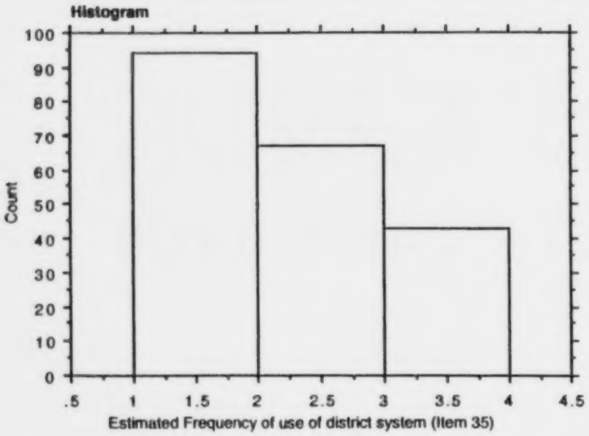
Key
1 = Have heard of district mail system
2 = Have not heard of district mail system



Frequency Distribution for Item 34

From (≥)	To (<)	Count	Percent
1.000	2.000	153	40.157
2.000	3.000	228	59.843
	Total	381	100.000

Key
1 = Use district mail system
2 = Do not use district mail system



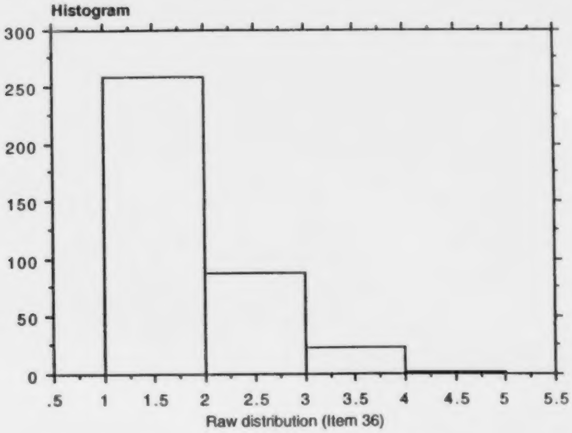
Frequency Distribution for Item 35

From (≥)	To (<)	Count	Percent
1.000	2.000	94	46.078
2.000	3.000	67	32.843
3.000	4.000	43	21.078
	Total	204	100.000

Key
1 = Less than 5 times per week
2 = Between 5 and 25 times per week
3 = Over 25 times per week

Access to a Computer in School

Access to a computer data was gathered from item 36. Two variables are derived from the raw data gathered with this item. The first variable determines whether or not the participant has a computer in their classroom or office (at their workspace). The second variable determines whether or not the participant has easy access to a computer in the school.

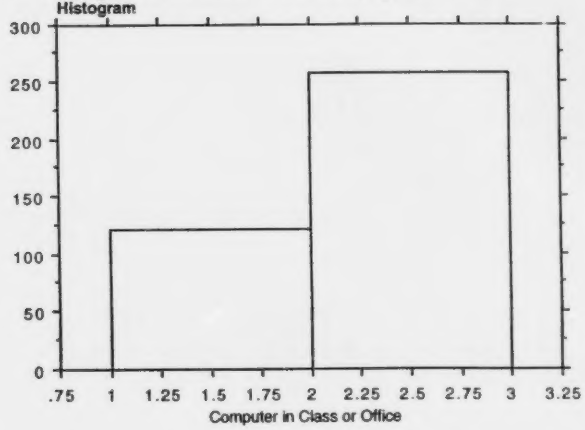


Frequency Distribution for Item 36

From (≥)	To (<)	Count	Percent
1.000	2.000	260	69.705
2.000	3.000	88	23.592
3.000	4.000	23	6.166
4.000	5.000	2	.536
	Total	373	100.000

Key
1 = Have a computer at workspace
2 = Do not have at workspace but have easy access
3 = Do not have easy access
4 = Have no access

Computer at Workspace

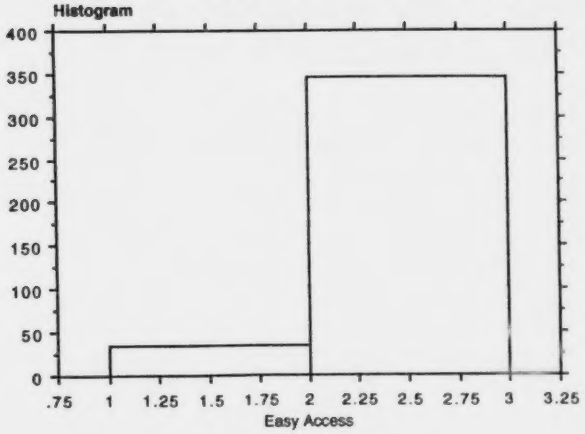


Frequency Distribution for Computer in Class

From (≥)	To (<)	Count
1.000	2.000	122
2.000	3.000	258
	Total	380

Key
1 = Do not have a computer at workspace
2 = Have a computer at workspace

Ease of Access at School

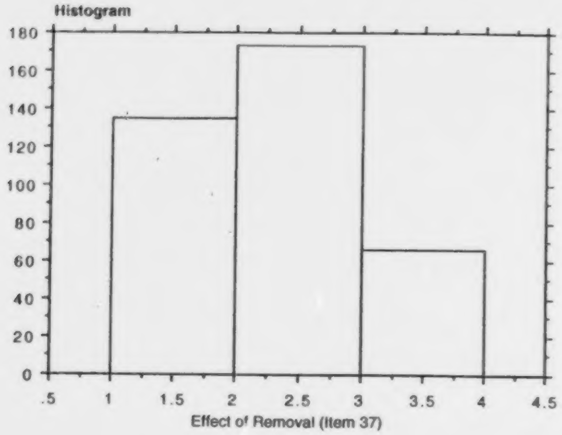


Frequency Distribution for Easy Access

From (≥)	To (<)	Count
1.000	2.000	34
2.000	3.000	346
	Total	380

Key
1 = Do not have easy access at school
2 = Have easy access at school

Effect of Removal of all Computers



Frequency Distribution for Item 37

From (≥)	To (<)	Count	Percent
1.000	2.000	135	36.096
2.000	3.000	173	46.257
3.000	4.000	66	17.647
	Total	374	100.000

Note: See the section on Levels of Use for a complete analysis of item 37.

Appendix D: Descriptive Statistics and Correlation Matrix for all Variables

Table 22: Means Scores for all Variables for Total Sample

Variable	n	Mean	SD.	Possible Range	Actual Range
Use of District mail System	380	1.397	.490	1-2	1-2
Frequency of Use of District Mail System	380	85.105	193.968	0-n	0-1909
LCU (3 position continuous)	296	.949	.541	1-3	1-3
Integration	245	1.147	.355	1-2	1-2
LCU 4-12	321	5.685	2.750	4-12	4-12
Effect of Removal	322	1.407	.492	1-2	1-2
Affective Attitudes	380	48.855	10.834	10-70	10-70
Cognitive Attitudes	380	18.168	3.167	3-21	3-21
Innovativeness	380	49.634	8.436	10-70	25-70
Self-Competence	379	5.529	1.528	1-7	1-7
Jurisdiction	380	1.597	.491	1-2	1-2
Computer at Workspace	380	1.679	.467	1-2	1-2
Home Computer	379	1.609	.489	1-2	1-2
Gender	380	1.418	.494	1-2	1-2
Age	380	40.54	9.580	23.0	60.5

Table 23: Frequency Distribution for all No/Yes Variables for Total Sample

	Know		Use		Dist ID		Other ID		Home		Comp Work	
	n	%	n	%	n	%	n	%	n	%	n	%
No	72	18.9	229	60.3	266	70.0	348	91.6	148	39.1	122	32.1
Yes	308	81.1	151	39.7	114	30.0	32	8.4	231	60.9	258	67.9
T	380	100	380	100	380	100	380	100	379	100	380	100

Table 24: Frequency Distribution for LUA

	LU A			
	Jur X		Jur Y	
	n	%	n	%
Non Use	32	25.0	19	11.3
Utilization	88	68.8	121	72.0
Integration	8	6.3	28	16.7
Total	128	100	168	100

Table 25: Frequency Distribution for Effect of Removal Scale

	Effect of Removal			
	Jur X		Jur Y	
	n	%	n	%
No Effect	36	24.5	29	12.8
Little Effect	74	50.3	99	43.8
Significant Effect	37	25.2	98	43.4
Total	147	100	226	100

Table 26: Frequency Distribution Access to a Computer at School

	Acc to Comp			
	Jur X		Jur Y	
	n	%	n	%
no access	2	1.4	0	0
no easy access	17	11.6	6	2.6
easy access	73	50.0	15	6.7
computer in classroom or office	54	37.0	204	90.7
Total	146	100	225	100

Appendix D: Descriptive Statistics and Correlational Matrix for all Variables

Table 27: Correlation Coefficients and n-values for Integration Level of Use Variable, E-Mail Variables, Predictor Variables, and Other Variables for Total Sample

Variable	LCU	Int	LCU 4-12	Rem	Use DM	Freq Use DM	Aff Att	Cog Att	Inn	Self C	Jur	C at Work	Home	Gen	Age
LCU		1.00††	1.00††	.515††	.240††	.202†	.360††	.336††	.304††	.399††	.221††	.268††	.142*	.078	-.166**
Int	245		1.00††	.515††	.202**	.138*	.193**	.262††	.230†	.230†	.144*	.154*	.075	.124	.001
LCU 4-12	245	245		.533††	.200†	.122*	.226††	.262††	.189†	.222††	.143*	.175**	.070	.138*	-.020
Rem	241	241	314		.199†	.223††	.262††	.243††	.206†	.243††	.169*	.238††	.002	.195†	-.107
Use DM	296	245	321	322		.520††	.199††	.190†	.026	.192†	.667††	.501††	-.016	-.078	-.225††
Freq Use DM	296	245	321	322	380		.168†	.133**	.116*	.119*	.361††	.291††	.019	-.012	-.100
Aff Att	296	245	321	322	380	380		.300††	.315††	.443††	.200††	.214††	.090	.133*	-.169†
Cog Att	296	245	321	322	380	380	380		.204††	.423††	.161*	.115*	.070	.090	-.117*
Inn	296	245	321	322	380	380	380	380		.283††	.070	.112*	.156*	.027	-.137**
Self-C	294	243	319	320	378	378	378	378	378		.135**	.123*	.152**	.081	-.161**
Jur	296	245	321	322	380	380	380	380	380	378		.573††	.003	-.043	-.199††
C Work	296	245	321	322	380	380	380	380	380	378	380		.050	.081	-.070
Home C	295	244	320	321	379	379	379	379	379	377	379	379		.187†	.095
Gender	296	245	321	322	380	380	380	380	380	378	380	380	379		.171†
Age	296	245	321	322	380	380	380	380	380	378	380	380	379	380	

* p< .05. **p < .01. † p < .001 †† p < .0001